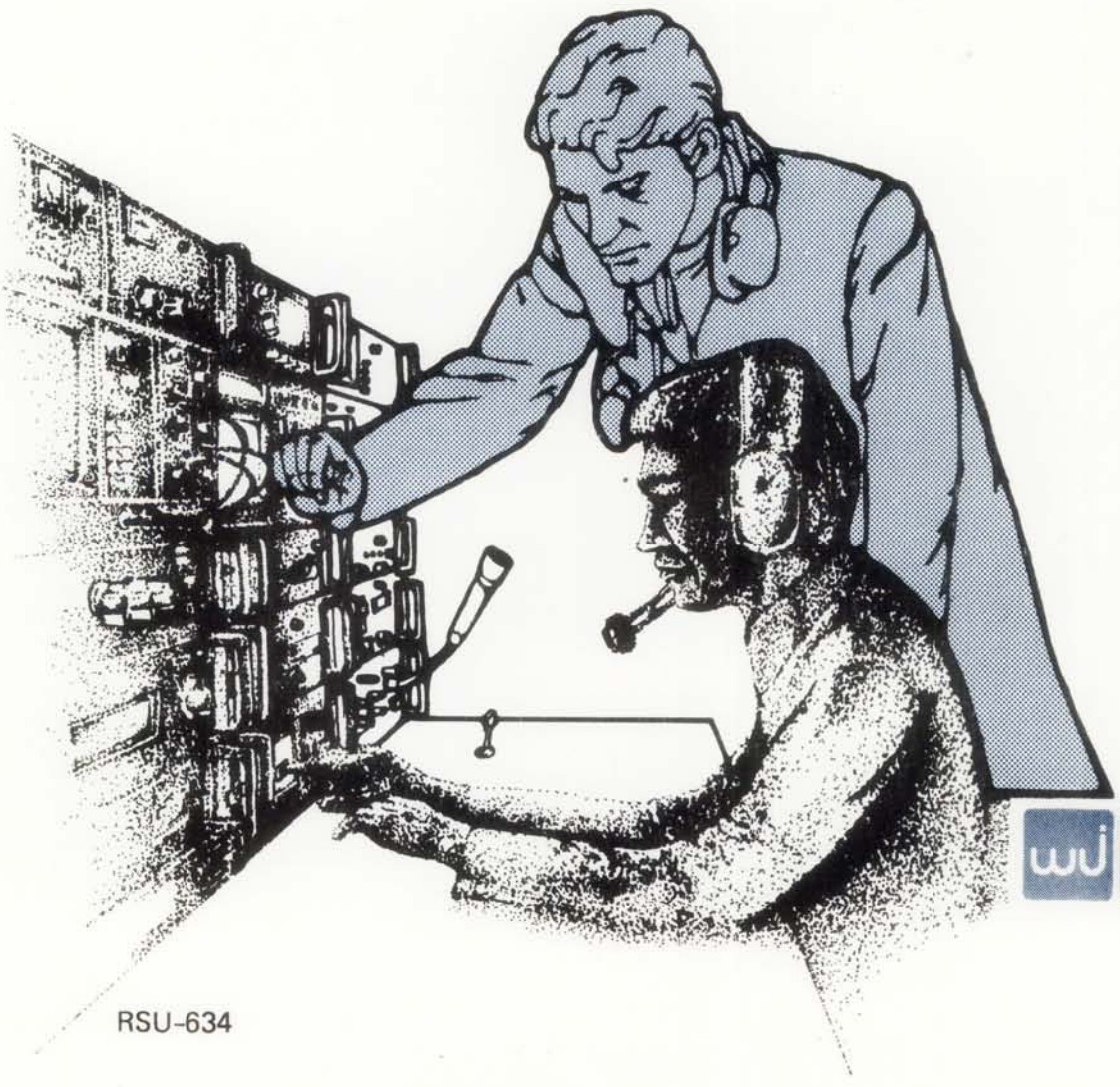
Operation and Maintenance Manual for Tuning Units TU0145 1.0 - 4.5 GHz, TU0412 4.0 - 12.4 GHz, TU0112 1.0 - 12.4 GHz, Parts of the WJ-8969 Microwave Receiving System



RSU-634

WATKINS-JOHNSON

15 AUGUST 1987

OPERATION AND MAINTENANCE MANUAL
FOR
TUNING UNIT TU0145 1.0–4.5 GHz
TUNING UNIT TU0412 4.0–12.4 GHz
TUNING UNIT TU0112 1.0–12.4 GHz

PARTS OF THE
WJ-8969 MICROWAVE RECEIVING SYSTEM

WATKINS-JOHNSON

WATKINS-JOHNSON COMPANY
2525 North First Street
San Jose, California 95131-1097

RSU-633

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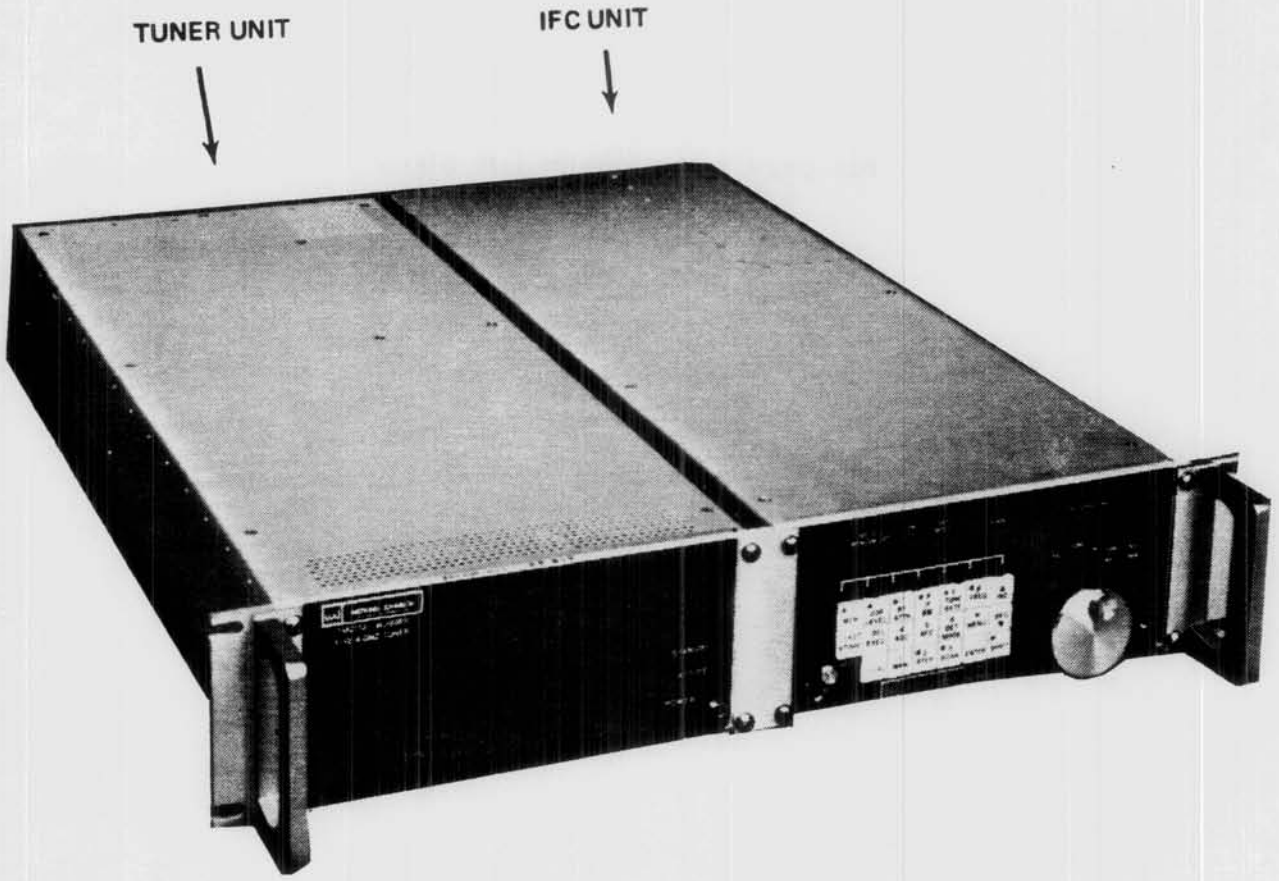

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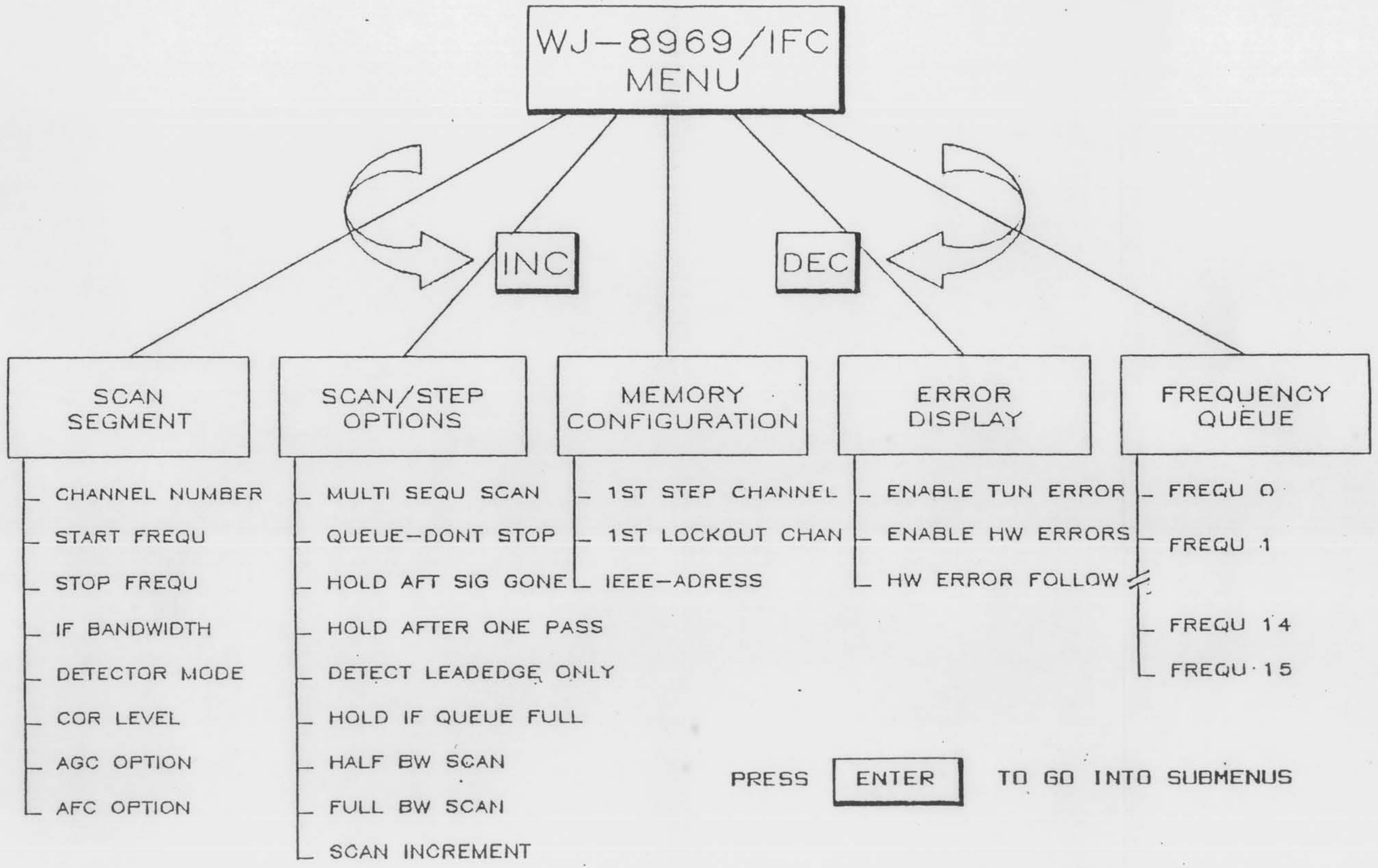
Figure 1-0. WJ-8969 Microwave Receiving System



SECTION I

GENERAL DESCRIPTION

1.1 ELECTRICAL CHARACTERISTICS

1.1.1 OVERVIEW OF IFC UNIT AND WJ-8969 SYSTEM

The WJ-8969 Microwave Receiving System is designed for wideband and narrowband applications in the microwave frequency range. The receiving system's RF tuning range is determined by interchangeable tuner units which provide the RF/IF conversion for the desired frequency range. Five fully synthesized tuner units provide a choice of 1.0 to 4.5, 4.0 to 12.4, 12 to 18, or 1.0 to 12.4 or 1 to 18 GHz tuning ranges. Other tuning ranges can also be accomplished for special purposes. Receiver detection modes include simultaneous AM and FM as well as CW (if the 21.4 MHz Converter/Filter Module option is installed) and Pulse. An optional Log detector is also available.

The receiver system is comprised of the WJ-8969/IFC IF Demodulator/Control and the WJ-8969/TUXXXX Tuner Units. These two half-rack units, both 3-1/2 inches high, can be attached side by side and installed in a standard 19-inch equipment frame, or the tuning unit may be installed in a remote location. Signal and control interconnection is provided by a single 50-ohm coaxial cable that can be as long as 300 feet. Using special coaxial cables, this length may be increased up to 1,000 feet. A two-way data link on the same cable permits remote control and status indication of the tuner unit.

Four wideband IF bandwidths (160 MHz center frequency) of the customer's choice are supplied as standard with each receiver. The system can provide up to eight operator-selectable IF bandwidths comprised of four narrowband (10 kHz to 5 MHz) and four wideband (10 MHz to 50 MHz) bandwidths. Other IF bandwidth combinations are possible. The installation of any narrowband IF bandwidth (21.4 MHz center frequency) requires the installation of an optional downconversion module.

All system control is provided via the WJ-8969/IFC IF Demodulator/Controller unit. It permits operator control from its front panel or through an interface with an external remote controlling device via the IEEE-488 interface. When in the local control mode, all system control is exercised via the front panel controls and indicators. The front panel keyboard permits rapid frequency input for discrete frequency tuning, frequency scanning, and stepping up or down in frequency by a designated step size. Conventional tuning can also be accomplished using the front panel optical encoder tuning wheel which provides variable rate tuning to 1 kHz increments. The front panel keyboard provides rapid selection of IF bandwidths, detection mode, gain control, and tuning rate. A 24-character alphanumeric display simplifies radio operations, particularly the memory and scan functions.

All control settings are prominently displayed for operator viewing. When in remote control mode, the same control functions are exercised by the remote controlling device via the remote interface. The front panel will display the remote selections but the keyboard is disabled to prevent conflicts in the control operation.

Use of the IFC unit front panel is discussed in Section II of RSU-634. The section also includes a detailed description of all controls, indicators, and displays. Additionally, typical operating procedures for the WJ-8969 system and IFC unit are also included in Section II of RSU-634.

The rear panel of the Tuner unit contains all connectors for the unit. Section II summarizes the purpose of all connectors. Figure 2-1, in Section II of this manual shows the rear panel of the unit and Figure 2-2 shows the front panel.

Section III provides theory of operation details for the Tuner unit. Schematics for the various boards and assemblies in the Tuner unit are contained on foldouts at the end of this manual.

Section IV details preventive and corrective maintenance procedures and also covers troubleshooting methodologies and procedures. Maintenance operations are straightforward due to clean mechanical packaging and the placement of most components on plug-in circuit boards.

Adjustments and alignments have been minimized. Removing the top and side covers of the Tuner unit exposes the assemblies, most of which can be removed from the main chassis with a minimum amount of effort.

1.1.2 RF INPUT CHARACTERISTICS

The WJ-8969 system has a single RF input port which covers the entire input frequency range. The RF input connector is type N and is located on the rear panel of the tuner unit.

1.1.3 FREQUENCY RANGE

The WJ-8969 system is tunable over a frequency range determined by the front-end unit in the tuner. It tunes in synthesized frequency steps of 1 kHz and is tunable from either IFC unit front panel controls or through a remote IEEE-488 interface port located on the IFC unit.

TU0145: 1.0 to 4.5 GHz
TU0412: 4.0 to 12.4 GHz
TU1218: 12 to 18 GHz
TU0112: 1.0 to 12.4 GHz
TU0118: 1.0 to 18 GHz

1.1.4 TUNING CHARACTERISTICS

The WJ-8969 system uses three conversions with two local oscillators to translate RF input signals to a 160-MHz IF output. The first LO of the RF tuner uses a single loop indirect synthesis technique. The

second LO of the RF tuner utilizes a two-loop indirect synthesis technique. The resultant tuning resolution of the RF tuner is 1 kHz.

1.1.5 TUNING RESOLUTION

Tuning resolution of the WJ-8969 system is 1 kHz regardless of the IF bandwidth selected.

1.1.6 FREQUENCY ACCURACY

The frequency accuracy of the WJ-8969 receiver is totally dependent upon the 10 MHz internal crystal oscillator used in the A9-Reference/ Multiplexer Module (in the IFC unit) unless an external reference signal is supplied to the system. The stability of the internal crystal and, therefore of the WJ-8969 system, is 3 parts in 10^7. The frequency accuracy of the system, when provided with an external reference signal, is dependent upon the fre- quency stability of the supplied reference signal.

1.1.7 EXTERNAL FREQUENCY REFERENCE

The WJ-8969 system uses a 10-MHz crystal oscillator to provide long-term unit stability for the receiver. This crystal oscillator is located in the IFC unit so that the tuner may be remotely located in more extreme environmental conditions. A 50-MHz crystal oscillator, located in the tuner, is phasedlocked to the 10-MHz oscillator in the IFC by a very narrow loop bandwidth of approximately 10 Hz. Therefore, the 50-MHz crystal's phase noise dominates at offsets of greater than 10 Hz.

There is an external reference port on the rear panel of the IFC which provides the ability to phase lock the receiver to an external 10-MHz (standard) or 5 MHz (option) signal. The input power to the receiver for the external reference is 0 ±3 dBm. The phase noise of the external reference need be no less than the following coordinates (offsets greater than loop bandwidth):

Phase Power in a 1-Hz Bandwidth (dBc)	Offset from Carrier (kHz)
-100	0.1
-130	1.0
-140	10.0

The external reference should have an accuracy of ± 1 ppm.

1.1.8 PHASE NOISE

The phase noise performance of the WJ-8969 system, at offsets of 100 Hz and greater, is determined by the receiver's internal 50-MHz crystal oscillator and its assorted local oscillators. The system's phase noise performance is therefore independent of the phase noise of an external reference. Table 1-1 contains the SSB phase noise specifications.

1.1.9 RESPONSE TIME

The WJ-8969 uses two synthesized local oscillators. The tuner's first LO is dominant for frequency steps greater than 1 MHz; the second LO is dominant for frequency steps less than 1 MHz. Scan mode takes a step approximately every 38.0 msec. If the step crosses a relay, the delay puts the inter-step time at 133.0 msec. These times may vary 1.0 to 1.5 msec.

Step mode dwell time is more complex. Before a step is taken, the tuner must lock and send a status work. This time varies but after the status word is received (indicating that either the tuner is locked or the tuner software timed-out waiting to lock), there is a 20 msec. dwell. The lock time has only a few discrete time values which depend upon the step-size chosen: 32-34 msec., 50-52 msec., 67-69 msec., 84-86 msec., and 120-122 msec. Add 20 msec. to these times to obtain the time between steps.

1.1.10 GAIN CHARACTERISTICS

The WJ-8969 system allows gain control in both the manual and automatic modes over a 90-dB range, minimum. The gain control range is a result of the voltage-controlled attenuators and fixed gain amplifiers distributed throughout the IFC. Each of four voltage controlled attenuators allows local gain control over a range of approximately 30 dB. This allows a total gain control range of 120 dB. However, a portion of the gain control range is used for bandwidth cable normalization, so the gain control range is less than 120 dB (90 dB, minimum).

1.1.11 AUTOMATIC GAIN CONTROL

The attack and decay characteristics of the AGC are optimized for pulsed baseband signals when operated in the PULSE mode. A pulse amplitude of 1.6V zero-to-peak (±0.2V) is maintained at the AM video port under the following conditions:

Pulse Width	1 ±0.1 microsecond
Minimum Pulse Repetition Interval	50 microseconds
Maximum Pulse Repetition Interval	10 milliseconds
Minimum (or greater) Selected IF Bandwidth	1 MHz
Maximum RF Input Power	-10 dBm
Minimum RF Input Power	-55 dBm

The WJ-8969 system incorporates a software AGC function which is superior to traditional hardware AGC loops. The primary advantage to the software AGC is the ability to incorporate multiple AGC characteristics without the need for large amounts of circuitry. In addition, the character -istics of the AGC loop can be modified with ease to satisfy different customer requirements.

The principle behind the software AGC is that the microprocessor is placed at the control point of the loop. It obtains signal level information from the AM and AM peak detectors. The signal level is sampled in a complex manner, and the gain is adjusted automatically for optimum

performance. The software AGC characteristics are different for each receiver mode (for different types of received signals) so the AGC loop is not just optimized for pulsed signals. The software AGC is capable of fast attack and response without tracking modulations.

In the pulse mode, the software AGC takes advantage of tools that are not available to the hardware AGC designer, such as sample-and-hold-forever and sample-and-forget routines.

The characteristics of the AGC in the pulse mode are a fast attack, hold, and slow decay. The signal is peak detected over a 25 ms window and the gain is adjusted in coarse steps until the signal level is within a certain range. The fine adjustment algorithm then takes over to maintain the signal within the AM detector's usable range. The AGC then holds the gain constant as long as pulses continue to appear, or until 250 milliseconds have passed with no received signal. The gain is increased at a rate of 20 dB every 5 ms thereafter until another signal is encountered.

1.1.12 MANUAL GAIN CONTROL

Manual gain control is provided with a 1 dB resolution. Manual gain control can be exercised via front panel keyboard or over the IEEE-488 interface. Control of voltage controlled attenuators in the IFC is performed by the microprocessor through D/A converters.

1.1.13 AUTOMATIC FREQUENCY CONTROL

This feature is implemented through the AFC key on the IFC unit front panel or via the IEEE-488 interface. AFC is useful to an operator for maintaining a changing or unstable RF signal within the receiving passband. Note, however, that the AFC feature is not functional in the BW filter bypass mode.

When AFC is selected, it is active only when the COR level indicator is lighted (meaning that a selected signal has exceeded the COR level threshold). When active, AFC tunes the tuner to maintain the signal in the center of the tuner's passband. The pull-in range depends on the signal strength and the accuracy of the AFC function is dependent on the selected bandwidth.

1.1.14 IF CHARACTERISTICS

1.1.14.1 IF Center Frequencies

The WJ-8969 system's IF center frequencies are 160 and 21.4 MHz (optional). The composite signal from Tuner to IFC includes a 160 MHz IF signal. The 160 MHz IF signal is downconverted to 21.4 MHz inside the IFC. Both the 160 and 21.4 MHz IF signals are available at the rear panel of the IFC.

1.1.14.2 IF Bandwidths

The IFC unit has eight slots for IF bandpass filters, four

centered at 160 MHz and four centered at 21.4 MHz. The 160 MHz filters available range from 10 MHz to 50 MHz, while the 21.4 MHz filters are offered in the range from 0.01 MHz to 5.0 MHz.

The filters are plug-in types and are easily field replaceable. If the filters are to be changed, a plug-in equalizer pack must also be changed so that the microprocessor can interrogate the demodulator at power-on to determine what filters are currently installed. The mean time to replace IF filters and associated equalizer pack in a single system is less than one hour.

The WJ-8969 system incorporates IF bandpass filters with a maximum shape factor of 4:1. For the 160 MHz filters, the resultant filter design yields a seven-section symmetrical phase and gain response, which is optimized for NPR performance.

1.1.14.3 Auxiliary IF Outputs

The WJ-8969 receiver provides three IF outputs consisting of a 160-MHz IF output, a 21.4-MHz IF output, and a switched IF output. The 160 MHz and 21.4 MHz IF outputs are referred to as signal monitor or SM outputs. The 160-MHz IF output is available prior to any IF bandwidth selective filtering. The 21.4-MHz IF output is provided with an approximate 8 MHz bandwidth. The output impedance of the IF outputs is 50 ohms and will not exceed a VSWR of 1.5:1. The gain from the IF input port of the IFC unit to the 160 MHz and 21.4 MHz SM (signal monitor) outputs are approximately 0 and 5 dB ±2 dB respectively.

1.1.15 IMAGE REJECTION

The receiver's image rejection is 70 dB minimum. For center tuned frequencies between 1 to 4 GHz, image rejection is determined by both the preselector filter and the single lowpass filter following the preamplifiers. For center tuned frequencies between 4 to 12 GHz and 12 to 18 GHz, the image rejection is determined by the combined pre- and post-selected YIG filter rejection at the image frequency. This filter has greater than 70 dB total rejection with respect to its insertion loss at the image frequencies.

1.1.16 VIDEO OUTPUT CHARACTERISTICS

The WJ-8969 system provides both AM linear and FM video output in addition to a switched video output which is automatically selected as a function of the receiver operating mode. Unused ports must be terminated with a 50-ohm BNC terminator.

1.1.16.1 FM Video and Switched Video Out

When in the FM Detection Mode, the following outputs are available:

FM Output: -0.5 Vdc to +0.5 Vdc ±0.05 Vdc, equivalent to 1 volt peak-to-peak, dc-coupled.

Switched Video Output: -1.0 Vdc to +1.0 Vdc ±0.01 Vdc, equivalent to 2 volts peak-to-peak, dc-coupled.

1.1.16.2 AM Video and Switched Video Out

The switched video and AM video output level, when operating in the AM mode, is 2 volts ±0.2 volts zero-to-peak for a 80% amplitude modulated carrier terminated into 50 ohms. The output does not saturate at less than 2.5 volts. The AM outputs are dc-coupled.

1.1.16.3 AM Output Distortion

The selected video output exhibits less than 3% of harmonic distortion when demodulating a 90% amplitude modulated carrier when the modulation signal frequency is significantly less than 1/2 of the selected IF bandwidth for all IF bandwidths.

1.1.16.4 Impedance

The output impedances of the selected video output, AM output, and FM output are each controlled by resistors in the circuits and are set to 50 ohms.

1.1.16.5 Video Bandwidth

When selecting the AM detection mode, the video bandwidth of the selected video output is greater than 25 MHz. Thus, the demodulated signal video frequency response is determined by the IF bandwidth selected and is, typically, extending from dc to one-half the selected IF bandwidth.

When the FM detection mode is selected, an equalizer circuit is switched into the FM video amplifier in order to set the output level as stated in paragraph 1.1.15.1. In addition, the equalizer controls the FM video bandwidth. The equalizer sets the FM video bandwidth at one-half of the IF bandwidth in order to limit the wide band noise that is present in FM demodulation. As a result of these equalizers, the FM video frequency response extends from dc to one-half of the selected IF bandwidth.

1.1.17 AUDIO OUTPUT CHARACTERISTICS

The audio outputs are available for listening to FM, standard type AM, and pulse transmissions:

1. Variable - a PHONES connector and AUDIO LEVEL control on the IFC unit front panel provide this feature. The connector is intended to drive an unbalanced 600-ohms stereo headphone set. Active only when COR threshold is exceeded.

2. Fixed - a BNC connector on the IFC unit provides this feature. The audio level is adjustable by a potentiometer accessible through the rear panel of this unit. The connector can drive a 50 ohm source.

1.1.17.1 Fixed Audio Connector (J12) Audio Specifications

The following lists the typical minimum and maximum voltage output levels for (1) a 50-ohm load, (2) AM modulation, and (3) with AGC on.

Mod. %	Min.	Max.
95	0.00V	250mV
75	32mV	220mV
50	64mV	195mV
10	110mV	143mV
1	130mV	130mV

1.1.17.2 PHONES Connector Audio Specifications

The following lists the typical minimum and maximum voltage output levels for (1) an unbalanced 600-ohms stereo headphone set, (2) AM modulation, (3) AGC on and (4) COR active. The first listing assumes a 50-ohm load on the fixed audio output, the second listing assumes no 50-ohm load on the fixed audio output.

50-ohm Load on Fixed Audio Output Connector

Mod. %	Min.	Max.
95	-1.32V	0.35V
80	-0.30V	0.30V
60	-0.23V	0.22V
40	-0.15V	0.15V
20	-0.07V	0.075V
10	-0.038V	0.040V

50-ohm Load on Fixed Audio Output Connector

Mod %	Min.	Max.
95	-1.40V	1.40V (clipped)
80	-1.20V	1.20V
60	-0.93V	0.90V
40	-0.60V	0.60V
20	-0.31V	0.31V
10	-0.15V	0.15V

1.1.18 LOCAL CONTROL

Local control of the WJ-8969 system is provided by the front panel of the IFC unit. The front panel of the IFC unit allows an operator to control the following parameters of the system: tuned RF frequency; IF bandwidth (one of 8 IF bandwidths if option AA is installed); IF attenuation (0 to 90 dB); detection modes (AM, FM, CW, and pulse); receiver scan modes

(step or scan); automatic gain control (on/off); automatic frequency control (on/off); memory/receiver configuration; carrier operated relay (COR) threshold level; lockout frequencies; and audio gain.

1.1.19 REMOTE CONTROL

Remote control and status reporting of the WJ-8969 system is provided through the IEEE-488 interface bus. The IEEE-488 interface bus permits the control of all front panel operation. Control resolution, in the remote control mode, is not degraded. In addition, all displayed information and the results of the built-in-test function are available on the IEEE-488 interface bus.

The IEEE-488 interface provides talk and listen capabilities to implement the following standard IEEE-488 functions.

SH1	Source handshake
AH1	Acceptor handshake
T6	Basic talker with serial poll
L4	Basic listener with serial poll
SR1	Service request
DC1	Device clear

1.1.20 BUILT-IN-TEST

The WJ-8969 system provides for built-in-test functions. Fault detection within the receiving system is dynamic and therefore does not necessitate an operator to be cognizant of a possible error before initiation of the self-test function. The system fault error messages include:

1. First LO unlocked;
2. Second LO unlocked;
3. Reference unlocked;
4. Calibration error--tuner cable;
5. Tuner not responding;
6. A to D converters are not converting;
7. No IF bandwidths found;
8. Illegal bandwidth codes in the receiver;

The messages are displayed on the front panel of the IFC unit. The exact formats for the messages and other technical details are contained in Section IV of the RSU-634.

The first three messages pertain to the phase-locking of the two LOs and the 50 MHz crystal reference. These devices are checked continously for phaselock. The other five messages can appear only during the "Power-Up" sequence since the devices associated with these messages are checked only during the power-up sequence.

1.1.21 PRIME INPUT POWER

Voltage and power requirements for prime input power for the receiving system are 115/230 Vac (switch selected on each unit), single phase, 47 to 400 Hz operation. Power consumption of the WJ-8969 depends upon the system configuration:

a. 40 watts, IFC unit
b. 55 watts, Tuner (half rack)
c. 75 watts, Tuner (full rack)

When the WJ-8969 receiver consists of two half-rack mount chassis, prime input power needs to be provided to both the RF tuner and IFC chassis.

1.2 MECHANICAL CHARACTERISTICS

The following are the dimensions (in inches/centimeters) of the system units:

IFC - 3.5/8.89 (H) x 8.25/20.95 (W) x 20.0/50.8 (L)
TU0112 - 3.5/8.89 (H) x 8.25/20.95 (W) x 20.0/50.8 (L)
TU0145 - 3.5/8.89 (H) x 8.25/20.95 (W) x 20.0/50.8 (L)
TU0412 - 3.5/8.89 (H) x 8.25/20.95 (W) x 20.0/50.8 (L)
TU1218 - 3.5/8.89 (H) x 8.25/20.95 (W) x 20.0/50.8 (L)
TU0118 - 3.5/8.89 (H) x 16.50/41.91 (W) x 20.0/50.8 (L)

1.2.1 ACOUSTIC NOISE

Normal voice conversations can be carried on without raising the voice level. This means that a system chassis does not exceed 24 dBa acoustic noise at a distance of one meter.

Hazardous noise is interpreted by the Watkins-Johnson Company to mean acoustic noise exceeding 110 dBa at a distance of 0.25 meters to approximately 80 dBa at a distance of approximately four meters. The WJ-8969 system acoustic noise level is far below this type of acoustic noise.

1.2.2 STANDARDS OF MANUFACTURE

The WJ-8969 system is built in accordance with best commercial practices and workmanship standards, using MIL-STD-454 as guidelines. Fabrication of piece parts follow best commercial practices. Assembly, soldering and wiring follow Watkins-Johnson Company workmanship standards. Testing is conducted at the appropriate level to measure the functional performance using approved test procedures.

1.2.3 CHASSIS ENCLOSURES

The equipment chassis are designed so that replaceable components are readily accessible. All chassis covers are easily and completely removable, providing access to the internal SRUs where necessary for maintenance purposes.

The weight of the IFC unit is nominally 21 pounds (9.53 kg). The weights of the Tuners are as follows: all half-rack tuners are nominally 25 pounds (11.35 kg); the full-rack tuner is nominally 30 pounds (13.52 kg).

The WJ-8969 system is designed to facilitate the adjustment, testing, repair, or replacement of any component with a minimum of mechanical or electrical disconnection within the system operating constraints. Service loops are incorporated where possible/necessary for performance of maintenance activities. General purpose technician tools are sufficient for most maintenance actions, but special tools, materials, and devices are needed where required by the maintenance procedures discussed in Section IV of this manual.

1.3 ENVIRONMENTAL CONDITIONS

1.3.1 NON-OPERATING ENVIRONMENTAL CONDITIONS

The WJ-8969 system will survive, without damage or permanent performance degradation, the environmental conditions specified below:

1. Temperature: -20°C to +80°C/-4°F to +176°F

2. Relative Humidity: Up to 100 percent with condensation (condensed moisture must be removed and humidity established as noncondensing prior to restoration of operation).

3. Atmospheric Pressure: 25 to 32 inches of mercury.

4. Strain, jars, vibrations, or other conditions incident to normal maintenance, transportation, and handling.

1.3.2 OPERATING ENVIRONMENTAL CONDITIONS

The WJ-8969 system equipment can be installed and operated in an air-conditioned environment. The conditioned air can be introduced into the bottom of the rack and exited at the top of the rack.

The WJ-8969 system equipment meets all performance requirements when operated indoors in the following environment:

1. Ambient Temperature: 0°C to 50°C/32°F to 122°F

2. Relative Humidity: Up to 80 percent without condensation; and

3. Barometric Pressure: 25 to 32 inches of mercury.

1.3.3 TRANSPORTABILITY

The WJ-8969 system equipment can be transported by commercial land carriers or pressurized commercial air carriers without special handling provisions.

1.4 SYSTEM CONFIGURATIONS

The typical WJ-8969 system is a simple configuration consisting of two units, the IFC and the RF tuner unit. When both units are mounted side by side, they encompass one 19-inch rack, 3-1/2 inches high. For semi-remote applications, the tuner may be located away from the IFC by as much as 300 feet using a standard cable or up to 1,000 feet using special low loss cable. The single interconnecting cable relieves typical problems associated with multiple interconnecting cables. This same configuration can easily accommodate multiple receiver systems using IFCs and tuner units in matched sets as needed.

1.5 SUMMARY OF WJ-8969 SYSTEM SPECIFICATIONS

Tables 1-1 and 1-2 summarize the WJ-8969 system specifications.

Table 1-1. WJ-8969 System Specifications

Tuning Scheme	Frequency Synthesized Local Oscillators Locked to An Internal or External Frequency Reference
Frequency Range	Determined by Tuner Unit: TU0145: 1.0 to 4.5 GHz TU0412: 4.0 to 12.4 GHz TU1218: 12 to 18 GHz TU0112: 1.0 to 12.4 GHz TU0118: 1 to 18 GHz (other ranges may also be accomplished including below 1 GHz and Above 18 GHz)
Frequency Resolution	1 kHz, Synthesized
Input Reference Frequency	10 MHz Standard 5 MHz Optional
Internal Reference Accuracy	3 Parts in 10^7
Noise Figure	1 to 12 GHz: 15 dB, Maximum; 11 dB, Typical 12 to 18 GHz: 17 dB, Maximum; 13 dB, Typical
Noise Power Ratio	40 dB, Typical
Third Order Intercept	0 dBm, Typical
Image Rejection	70 dB, Minimum
SSB Phase Noise	1 to 12 GHz (dBc/Hz max) / 12 to 18 GHz (dBc/Hz max) / Δ fo -80 / -74 / 1 kHz -83 / -77 / 10 kHz -98 / -92 / 100 kHz -118 / -112 / 1 MHz
RF-to-IF Gain (RF input to 160 SM output)	18 dB, Typical (system does self-calibration to adjust for IF cable losses during power-on cycle)
RF Input Impedance	50 Ohms, Nominal

Table 1-1. WJ-8969 System Specifications - continued

LO Level at RF Input	-90 dBm, Typical
Single-tone Spurious Free Dynamic Range	60 dB, Minimum, 65 dB, Typical (Referenced to a 1 MHz Measurement Bandwidth)
Input 1 dB Compression Point	-10 dBm, Minimum
Internally Generated Spurs	Not Above Noise Floor in 1 MHz resolution bandwidth
Tuner IF	160 MHz Center Frequency
RF Input VSWR	2.0:1, Typical; 2.5:1, Maximum
Gain Control	Manual and AGC
Gain Control Range	0 to 90 dB, 1 dB Steps
Demodulation	AM, FM, CW and Pulse
Selectable IF Bandwidths	Up to Eight Installed Four Centered at 160 MHz and Four Centered at 21.4 MHz. See Table 1-2 for Values. Consult factory for details on 70 MHz center frequency option.
Video Outputs	AM (Linear) FM Selected (panel selection) AM (Log) - Optional
Video Response	DC to 1/2 Selected IF Bandwidth
Video Output Levels	AM (Lin): 0 to 2 Volts, DC Coupled FM: ±0.5 Volts, DC Coupled FM Selected Video: ±1.0 Volt, DC Coupled AM (Log): 0.2 to 2 Volts, DC Coupled
Video Output Impedance	50 Ohms, Nominal
IF Outputs (Signal Monitor)	160 MHz Unfiltered; 50 MHz BW, Typical 21.4 MHz (optional); 8 MHz BW, Typical Switched IF Filtered 70 MHz (optional - consult factory for details)

Table 1-1. WJ-8969 System Specifications - continued

Signal Monitor Output Impedance	50 Ohms, Nominal
Audio Outputs	Phone (600 ohm) and Line 50 ohm,
Remote Control	IEEE-488
Dimensions (inches/centimeters)	IFC - 3.5/8.89 (H) x 8.25/20.95 (W) x 20/50.8 (L) TU0112 - 3.5/8.89 (H) x 8.25/20.95 (W) x 20.0/50.8 (L) TU0145 - 3.5/8.89 (H) x 8.25/20.95 (W) x 20.0/50.8 (L) TU0412 - 3.5/8.89 (H) x 8.25/20.95 (W) x 20.0/50.8 (L) TU1218 - 3.5/8.89 (H) x 8.25/20.95 (W) x 20.0/50.8 (L) TU0118 - 3.5/8.89 (H) x 16.50/41.91 (W) x 20.0/50.8 (L)
Weight	IFC: 21 pounds (9.53kg) Tuner (half rack): 25 Pounds (11.35 kg) Tuner (full rack): 30 Pounds (13.62 kg)
Temperature Range	Operation: 0 to 50°C (32 to 122°F) Nonoperating: -20 to +80°C (-4° to 176°F)
Power Requirements	115/230 Vac ±15% (switch selectable) 47 to 400 Hz, Single Phase IFC: 40 Watts Tuner (half rack): 55 Watts Tuner (full rack): 75 Watts

Table 1-2. Available IF Bandwidths*

IF BW (kHz)	Center Frequency (MHz)	IF BW (kHz)	Center Frequency (MHz)
10	21.4		
20	21.4	10000	160
50	21.4	14000	160
100	21.4	15000	160
200	21.4	20000	160
250	21.4	22000	160
300	21.4	28000	160
500	21.4	30000	160
1000	21.4	36000	160
2000	21.4	50000	160
4000	21.4	*	160
5000	21.4		

*Other IF bandwidths are available upon request. Customers may select a maximum of four narrow (centered at 21.4 MHz) and four wide (centered at 160 MHz) IF bandwidths.

SECTION II

INSTALLATION AND OPERATION

2.1 UNPACKING AND INSPECTION

Examine the shipping carton for damage before the WJ-8969 Tuner unit is unpacked. If the carton has been damaged, try to have the carrier's agent present when the equipment is unpacked. If not, retain the shipping cartons and padding material for the carrier's inspection if damage to the equipment is evident after it has been unpacked.

See that the equipment is complete as listed on the packing slip. Contact Watkins-Johnson Company, San Jose, California; or your local Watkins-Johnson representative with details of any shortage.

The unit was thoroughly inspected and factory adjusted for optimum performance prior to shipment. Thus it is ready for use upon receipt. After unpacking and checking contents against the packing slip, visually inspect all exterior surfaces for dents and scratches. If external damage is visible, and internal damage is suspected, notify Watkins-Johnson Company representative. Do not remove the covers from the unit. This breaks the QA seal and voids the warranty.

2.2 PREPARATION FOR RESHIPMENT AND STORAGE

If the WJ-8969 Tuner must be prepared for reshipment, the packaging methods should follow the pattern established in the original shipment. If retained, the original materials can be used to a large extent or will at a minimum provide guidance for the repackaging effort. Conditions during storage and shipment should normally be limited as follows:

1. Maximum humidity: 95% (no condensation)

2. Temperature range: -20°C to +80°C (-4°F to +176°F).

2.3 INSTALLATION

The WJ-8969 Tuner is designed for mounting in a standard 19-inch equipment rack. It occupies 3.50 inches of vertical rack space, is 8.25 inches wide for the half-rack units, the full rack unit is 16.50 inches wide and extends approximately 20.75 inches into the rack to the tips of the rear connectors. Do not rely solely on front panel mounting hardware to support the receiver. A brace extending along the sides from the front panel to the rear panel is preferred. The rack should allow a free flow of air through top and bottom covers and side panels, as well as around the outer surfaces of the unit. The rack slides recommended for the tuner are the Johannson 1102D-20-2.

The half-rack unit weighs nominally 25 pounds (11.53 kg) and the full-rack unit weighs 30 pounds. They can be lifted safely, by a trained technician, without using a lifting device.

Access to the rear panel should be allowed so that input and output connections can be conveniently made or changed if desired. Figures 2-1 and 2-2 are photographs of the rear and front panels.

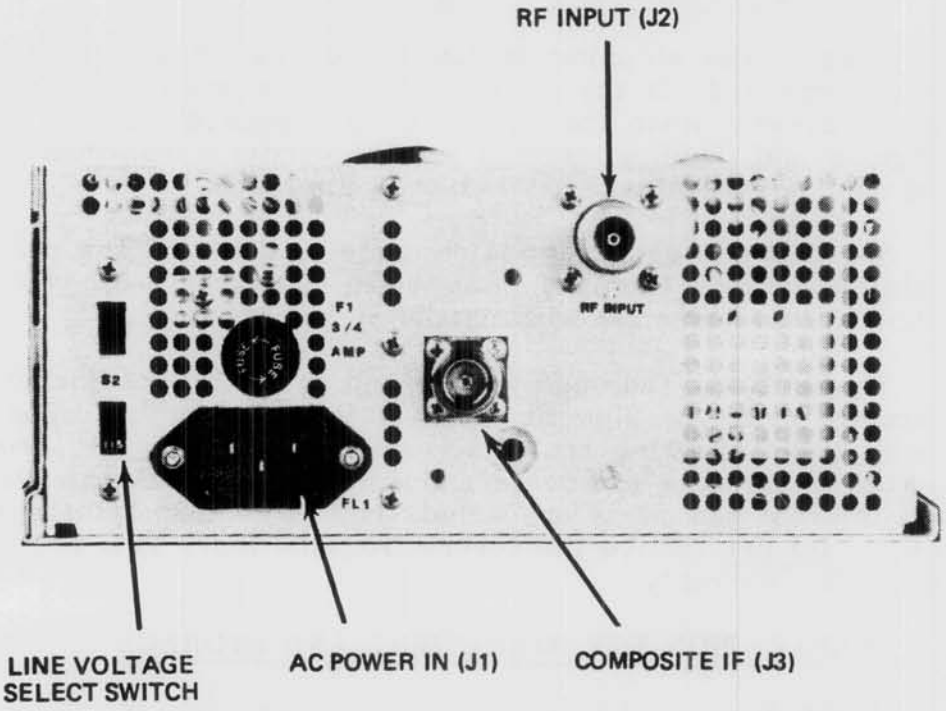


Figure 2-1. Rear Panel of the WJ-8969 Tuner Unit.

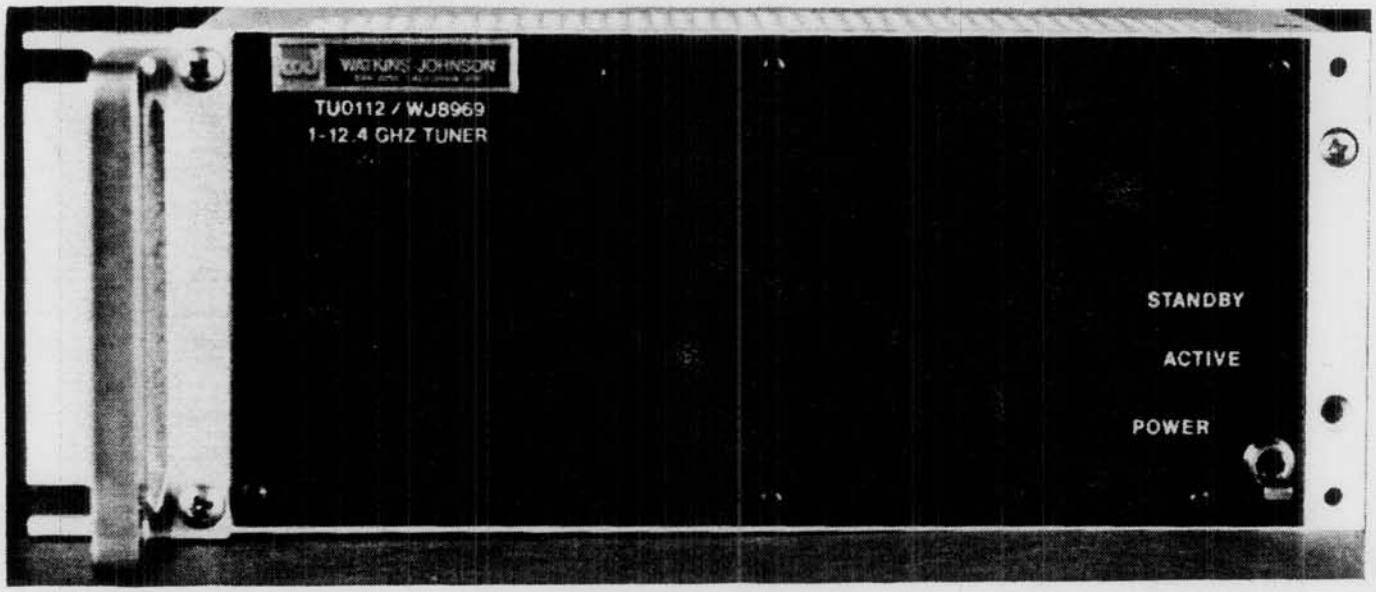


Figure 2-2. Front Panel of WJ-8969 Tuner Unit.

The following describes the functions and input/output parameters of each connector. A technician can trace the origins of the connector's signal sources by using Figure 6-1 (sheets 1 and 2) in Section VI. This figure is a functional block diagram of the WJ-8969 Tuner unit. Details of the connectors are given on Figure 6-17 (sheets 1 and 2) in section IV. This figure is the interconnect diagram of the tuner.

2.4 CONNECTORS

2.4.1 AC POWER INPUT (J1)

This POWER connector is a multi-pin connector cabling a user-supplied ac power source (115/230 Vac, 47 to 400 Hz) to the power supply in this unit. Figure 2-1 shows the location of the internal voltage select switch which has a 115 or 230 position. The setting of the switch depends on the voltage level of the ac power source. The switch is shown in the 115 position.

Fuse F1 is a 0.75 ampere slow-blow type and can be used for either 115 Vac or 230 Vac input power.

2.4.2 RF INPUT (J2)

This connector is an N-type female and permits the user to cable RF energy to the front end assembly (A7) of the tuner.

2.4.3 160 MHz IF INPUT, TUNER CONTROL, REFERENCE SEND (J3)

This connector is a N-type female and is used for connecting the WJ- 8969 system's single 50 ohm coaxial cable between the Tuner unit and rear panel connector J7 on the WJ-8969 IFC unit. Internally, this connector is coupled to the multiplexer circuit card in the reference/multiplexer module (A1).

The composite signal on this single interconnecting cable for the system's IFC and tuner units contains half duplex data, the tuner unit's 160 MHz IF frequency, and the IFC unit's 10 MHz reference signal. These three signals are frequency multiplexed onto this single cable. Multiplexing and demultiplexing of the signals and data are performed by the respective multiplexer circuit cards in the similar reference/multiplexer module contained in each unit.

2.5 FRONT PANEL CONTROLS

The tuner contains a POWER switch, which is the only front panel control. The STANDBY indicator lights when the tuner is in the "standby" mode. The ACTIVE indicator lights when the tuner is in the "active" mode.

In the "Standby" mode, the microprocessor has power and the YIG heater voltages are still active. This enables the unit to remain in a quiescent state so that it can respond immediately to data from a control

unit. This mode occurs whenever the IFC unit is turned off or when the cable between this unit and the IFC unit (or other controller) is disconnected.

In the "Active" mode, all internal power supplies and voltage regulators are active and the unit is receiving data from the IFC unit.

SECTION III

CIRCUIT DESCRIPTION

3.1 GENERAL

This section provides a functional analysis and detailed theory of operation for the following major assemblies of the WJ-8969/TUXXXX Tuner:

1. Reference/Multiplexer Assembly (A1), PN 659899-001
2. YIG Assembly (A2), PN 659859-001
3. Second L.O. Synthesizer Assembly (A3), PN 659901-001
4. First L.O. Synthesizer Assembly (A4), PN 659903-001
5. IF Assembly (A6), PN 659905-001
6. Front End Assembly (A7), part number depends on tuner type:
   - 1 to 4.5 GHz, PN 660340-001
   - 1 to 12.4 GHz, PN 660124-001
   - 4 to 12.4 GHz, PN 660380-001
7. Microprocessor Assembly (A8), PN 659842-001
8. Voltage Regulator Assembly (A10), PN 659846-001

The descriptions are arranged in a logical signal-flow presentation. The table of contents should be consulted for locating descriptions of specific assemblies.

The RF tuner unit provides the frequency translation function of converting the RF input frequencies to an IF output of 160 MHz. The RF to IF conversion is accomplished using synthesized local oscillators to obtain with a 1 kHz tuning step size. Frequency coverage of the tuner unit is dependent only on the RF front-end assembly. All other modules in the tuner remain unchanged and are independent of frequency coverage.

3.1.1 DIAGRAMS AND SCHEMATICS

Figure 6-1 is a two-sheet overall functional block diagram of the tuner unit. Detailed schematics for all assemblies and circuits within the assemblies are contained in Section VI.

3.1.2 OVERALL DESCRIPTION

Figure 6-1 shows the assemblies of the tuner which provide the frequency translation function of converting the RF input frequencies to an IF output. Figure 6-2 is the schematic for the tuner junction board showing the interconnections of the various boards in the tuner.

Figure 6-17 is the tuner interconnect diagram and shows the details of the interconnection within the tuner. The tuner, through use of various front end assemblies (A7), covers the following frequency ranges:

a. 1 to 4.5 GHz
b. 4 to 12.4 GHz
c. 1 to 12.4 GHz

and converts these frequencies to an IF output of 160 MHz. The RF to IF conversion is accomplished using synthesized local oscillators (LOs) to obtain a 1 kHz tuning step size.

The WJ-8969/IFC IF Demodulator and Controller unit is closely related to the WJ-8969/TUXXXX Tuner unit and, among other interrelation ships, provides control data and a 10 MHz reference signal to the tuner unit. Together, the IFC unit and tuner unit comprise the basic WJ-8969 microwave receiving system. For details regarding the IFC unit, refer to RSU-634 which is the operation and maintenance manual for this unit.

3.2 MICROPROCESSOR (A8) ASSEMBLY

3.2.1 FUNCTIONAL DESCRIPTION

The microprocessor circuit card assembly has its own 8 Vdc to 5 Vdc regulator that maintains dc power to the microprocessor circuits when the RF tuner is placed into the stand-by mode. The incorporation of a microprocessor into the RF tuner unit enables the tuner to manage its own functions through software control. The RF tuner microprocessor communicates with the IFC through serial data commands.

In addition, the microprocessor circuit card assembly contains a separate RS-232C port which is used for test and troubleshooting of the tuner when an IFC is not available. The microprocessor receives commands and performs the necessary calculations and sends out control signals to the various tuner modules.

3.2.2 DETAILED DESCRIPTION

Refer to figure 6-3. This board provides the control lines for the tuner unit and interfaces with the IFC unit to provide user control of the WJ-8969 tuners. The board consists of the following circuits:

1. Reset--VR1, U1A, U1B, and Q1
2. First and second local oscillators and Reference Generator/Multiplexer locked/ unlocked status--U26
3. Microprocessor--U4
4. Address Decoders--U5 and U13
5. Latch for PROM address from microprocessor--U22
6. CPU PROMs--U11 and U21

7. RS-232 Serial Interface--U14 (a UART--universal asynchronous receiver/transmitter), U24, U5, U10, U9, and associated circuitry.

8. Peripheral I/O--U20 (a PIO) which provides control lines to the tuner unit modules.

9. Digital to Analog Converter -- U6 (a DAC) and associated circuitry for control, via the microprocessor, of the variable attenuator in reference generator/multiflexer (A1) of the tuner unit.

As shown on figure 6-3, the internal connection between the tuner and the IFC unit is through the RSC-232 half duplex line connected to J2 on the microprocessor board. A test terminal can also be connected to this board using pins 4 and 9 of connector J1.

The microprocessor board functions as follows. Upon power-up, the tuner unit is initialized and goes into a standby mode. The front panel STANDBY indicator lights for this mode. While in the standby mode, the tuner's power supply is active and provides +18 Vdc, -18 Vdc, and +8 Vdc. The +18 Vdc is used to keep on the YIG heaters. The microprocessor board has its own +8 Vdc to +5 Vdc regulator (U3) to keep it active during the standby mode.

All other tuner modules require +15 Vdc, -15 Vdc, or +5 Vdc for operation. These voltages are generated primarily by the voltage regulator assembly (A10) which is controlled by the microprocessor through the PWR UP/DOWN control line (J1-25). This allows the tuner to be in a powered-down state, while permitting the microprocessor functions to operate.

This feature is particularly useful when the tuner is located remotely from the IFC unit. When the IFC unit is powered-off, the digital control communications between the tuner and IFC cease and the tuner automatically goes to the standby mode. When the digital control communications begin, the tuner becomes active again.

When the WJ-8969 is initially powered-up, it runs a self-test to check for any faults in the system. This feature allows for easy trouble-shooting or maintenance that may be needed. Error messages are displayed in the IFC unit's alphanumeric display describing any errors that may be present. Refer to RSU-634 for a description of these error messages. The message reporting may be cancelled if undesired. Receiver operation will continue on a limited basis depending on the error message.

Also, during power-on, the receiver runs a calibration mode that sets IF gain. This is accomplished by sending an internal signal of known amplitude over the interconnecting cable. This signal is detected in the IFC unit and commands are sent back to the tuner to set a voltage-controlled attenuator in the reference/multiplexor assembly (A1).

The control voltage is generated by DAC/U6 on the microprocessor board. This function allows the system to self-calibrate its gain for varying lengths of cable interconnecting the tuner and IFC units.

After all error checking and calibration is completed, the receiver enters the manual mode of operation. The receiver continues to check for internal system errors while in operation. The total power-on sequence takes about five seconds.

At power-on, U14 (the UART chip) is initialized for the following: asynchronous communication, 8-bits/word, even parity, one stop bit, a 19.2 K-baud rate with the IFC unit, and a 6.25 second timeout on IFC communications. U20 (the PIO chip) is initialized for the internal timer and to be in the power-down (standby) state.

U20 is used exclusively as an output device and is initialized for this use by the software. U20 has three different ports. Each port has a distinct function or set of functions. The output ports provide control for several modules within the tuner. Instead of detailing the purpose of each port bit for this discussion, the control lines to each individual module are grouped together.

Each module can receive one of two different types of control. The main type of control is the output of serial data requiring three separate control lines:

1. data line
2. clock line (to clock in data)
3. strobe line (to transfer clocked-in data)

The modules/circuits using this serial data (with the cited formats) are:

1. YIG Assembly (A2), 12-bits for coarse tuning the YIG LO
2. Phase Detector of YIG Assembly (A2A2), 4-bits for setting loop polarity of the phase-lock-loop
3. First LO Synthesizer Module (A4), 16-bits for setting frequency
4. Second LO Synthesizer Module (A3), 15-bits for initializing reference counters and 18-bits for setting frequency
5. Front End Assembly (A7), 16-bits for tuning the YIG filter

The other type of control is a latched data ouput providing bits to enable or disable functions in the modules. The modules using this latched data (with the cited formats) are:

1. IF Assembly (A6), 1-bit for IF selection
2. Front End Assembly (A7), 1-bit for enabling the assembly and 2-bits for selecting the assembly
3. Voltage Regulator (A10), 1-bit for powering on/off the power supply regulators

Tuning the tuner requires the occurrence of the following sequency of events; however, not all tuning modes require that all events take place:

1. 2nd LO Module, 15-bits for initializing reference counters
2. Front End Assembly, 16-bits for tuning the YIG filter
3. YIG Assembly, 12-bits for coarse tuning the YIG LO
4. 1st LO Module, 16-bits for setting the frequency
5. Phase Detector Circuit, 4-bits for setting loop polarity of the PLL
6. 2nd LO Module, 18-bits for setting the frequency

The tuner goes into an active mode when the IFC unit addresses the tuner through the serial RSC-232 interface. To remain in the active mode, the tuner must be addressed every 6.25 seconds otherwise it will enter the standby state.

Data is received from the IFC unit at pin-21 on U14. The presence of data in U14's internal input buffer causes pin U14-22 to go "low." This signals an input interrupt to the microprocessor chip U4 via U4-22.

When the complete command, accompanying the data, is received (a "terminator" code indicates termination of the command), the data is copied into a working buffer in U14. An input flag is set so that the message (data and command) can be processed. This allows the next command to start coming in before the last message's processing is completed. If the last message is not processed by the time the new message is complete, the new command is ignored and discarded.

After a complete message is received, the microprocessor checks the data to determine the command instruction and then jumps to the appropriate subroutine for the command. Any appropriate output messages are prepared by the called subroutine.

If the command is not legal, an error flag is set and indicated, as such, in the status byte being sent to the IFC unit. The known commands for the microprocessor board are:

1. Set the attenuation (to calibrate the interconnecting cable attenuation).
2. Query about relay breakpoints.
3. Query the tuner's RF range.
4. Power-up the tuner's front-end.
5. Power-down the tuner's front-end.
6. Turn-on the calibrator.
7. Stop calibration.
8. Set the frequency.
9. Set the step-size.
10. Add the step-size to the frequency (if the answer is legal).

11. Subtract the step-size from the frequency (if the answer is legal).

12. FQUERY status words and reset errors.

13. Get the tuner type and software version.

3.3 FRONT-END ASSEMBLY (A7)

3.3.1 FUNCTIONAL DESCRIPTION

This is the only assembly that determines the actual RF input frequency range. For the purpose of this discussion, the front-end that tunes from 1.0 to 12.4 GHz is used and is shown on figure 6-1. Figures 6-4, 6-5, and 6-6 are the interconnect diagrams for the 1-12.4 GHz, 1-4.5 GHz, and 4-12.4 GHz front end assemblies.

RF signals in the 1.0 to 12.4 GHz frequency range enter the RF tuner unit through a rear panel type N female connector and are routed to the RF front end module. The RF front-end module performs the switching, preselection, amplification, and control of the YIG filter driver. An SPDT RF switch is placed at the RF input to switch the received RF signals to one of two preselection paths.

For the 1.0 to 4.0 GHz frequency range, the RF input signals are filtered by a YIG preselector. The YIG filter provides approximately 40 to 50 MHz of RF bandwidth with 4 dB of insertion loss. The RF signal is then routed to an amplifier which has a low noise figure and approximately 20 dB of gain.

The low pass filter following the amplifier minimizes the broadband amplifier noise entering the first conversion mixer. In addition, this filter also provides further image rejection and LO rejection beyond that of the preselector filter.

For the 4.0 to 12.4 GHz frequency range, the receiver uses a dual two stage YIG filter for preselection. The YIG filter provides a nominal 50 MHz of bandwidth in addition to its image rejection and LO rejection. Inserted between the pre and post selector sections of the dual stage YIG filter is a 4 to 12.4 GHz amplifier. The 4 to 12.4 GHz amplifier provides the necessary gain and sets the receiver noise figure. By following the amplifier with the post selector section of the YIG filter, broadband noise is rejected before the mixer. Following the YIG filter is a broadband 4 to 12.4 GHz isolator which improves the 50-ohm match and further reduces the reverse LO signal.

A SPDT RF switch is used to combine the RF signals from the 1.0 to 4.0 GHz and 4.0 to 12.4 GHz frequency ranges and routes the RF signals to the tuner's first conversion mixer.

The YIG driver and control circuit board is also part of the RF front-end assembly. The control circuit board provides the circuitry necessary to enable only the preamplifiers and YIG filter being used for the particular tuned frequency.

3.3.2 DETAILED DESCRIPTION

Refer to Figure 6-4. The 1 to 12.4 GHz RF to this assembly is routed to a SPDT mechanical coaxial switch S1. Under microprocessor control, the RF is routed to YIG filters FL1 and FL2. FL1 is the low band filter for the 1 to 4.0 GHz RF and FL2 is the high band filter for 4 to 12.4 GHz RF.

3.3.2.1 Low Band Path

FL1 is a 4-stage filter having an approximate 40 MHz bandwidth, which increases to approximately 50 MHz as the filter is tuned-up in frequency. The output of FL1 goes to amplifier AR1 which has approximately 18 to 20 dB of gain. Attenuator AT1 is used for adjusting noise power for dynamic range and balancing the two paths in the front end.

At the output of AT1 is FL3 (a semi-rigid cable filter) with a cutoff frequency of 5 GHz. FL3 prevents the image noise, at the output of the amplifier, from reaching the mixer. This image noise could degrade the noise figure of the receiver. FL3 also prevents the LO from radiating back through the front end to the input of the tuner.

After FL3 is S2 (a SPDT mechanical coax switch) which recombines the previously split RF input. The output of this switch goes to the IF assembly (A6).

3.3.2.2 High Band Path

One output of switch S1 goes to FL2. FL2 is a dual 2-stage filter, which means it has 4-ports: a pre-selector input/output as well as a post-selector input/output. AR2 is a pre-amplifier between the pre-selection output and the post-selection input of the YIG filter.

The RF input comes into the pre-selector and then goes out of the pre-selector to the input of the amplifier. Signals go through amplifier AR2 and then go through the post-selector. The post-selector goes to attenuator pad AT2 (which is factory-selected and has an attenuation of between 1 to 2 dB). Amplifier AR2 has approximately 18 to 20 dB of gain.

AT3 is an isolator. It allows the signal to travel in the forward direction but attenuates a reverse traveling signal. AT3 prevents the strong LO signal from appearing at the RF input of the tuner, thereby improving the LO radiation specification of the receiver. AT3 also improves the matching between the YIG filter, through AT2, and mixer M83C located in the IF assembly (A6). At the output of AT3 is coax switch S2 which recombines the two portions of the frequency spectrum.

3.3.2.3 Dual YIG Filter Driver/Logic Controller

Refer to Figure 6-7. This CCA provides the current drive to each YIG filter and well as controlling the two amplifiers in the front end. Depending on which band is switched in, only that amplifier and YIG filter are turned-on. This feature saves power and heat.

This driver uses a 16-bit D/A converter (U5) to provide the reference voltage and the tuning voltage to each YIG device. The tuning voltage is shared by similar YIG driver stages.

The input tuning-word to the U5 is in parallel form. U3 and U4 convert the serial data from the microprocessor to the parallel data used by U5.

The reference voltage and tuning voltage output from U5 are passed through op amps U8A through U8D, for amplification, and are applied to driver transistors (Q3D/Q1 and Q3E/Q2) which drive the current into the tuning coils of the YIG devices.

As with all WJ-type YIG-drivers, the current through the YIG tuning coils is sensed by sense resistors (one is 4-ohm and the other is 1-ohm). The current is measured by the voltage drop across the resistor and is fed back through the feedback loop of the op amp. So, in each case, this is a closed loop design.

Drive transistors (Q1 and Q2) are Motorola MJE700 type and use a common emitter design where the current is flowing through the collector and is applied to the tuning coil of the YIG filter.

Feedback capacitors are used to limit the high frequency noise from being applied to the YIG filters. These are C13, C16, C12, and C17, This high frequency noise would be seen as random fluctuations in center frequency.

Diodes CR3, CR4, CR6, and CR7 prevent the op amps from applying too large a voltage to the drive transistors. The op amps can source to ±13 Vdc and the diodes prevent the bases of the drive transistors from going any lower than about -0.7 Vdc and any higher than +8.7 Vdc.

The zener diodes (VR1 and VR2) at the outputs prevent inductive voltage spikes from destroying the ICs on the board. These spikes are caused by collapsing magnetic fields during band-switching.

Transistors Q3D and Q3E enable and disable the appropriate YIG device. These transistors, preceded by resistors and inverters, essentially shut off the current to the output transistor in which ever band is not being used. By doing this, power is saved and the tuner operates cooler.

The YIG heaters are always turned on in both YIG devices because an operator might want to tune from the low band to the high band and not wait for the prescribed 15 minutes warmup period. The heaters maintain a constant temperature for the YIG devices.

The voltage regulators (U1, U2, and U7) for this board are shown on the upper left portion of figure 6-7. U7 regulates the +8 Vdc to +5 Vdc. U7, during power-up, prevents "glitches" from locking-up the logic on the board.

U1 and U2 regulate the input +18 Vdc down to +15 Vdc which is used to drive amplifiers AR1 and AR2. If the amplifiers were wired directly to +15Vdc they could not be shut off independently.

Band select lines A and B (SEL A and SEL B), shown on the left middle of of the schematic, are used to shut off the amplifier not being used in a particular band. Select B is tied-low by the microprocessor. SEL A will toggle between 0 and 1; 0 for low band and 1 for high band.

The purpose of the double-inversion, implemented by U10-A/ U10-B and U10C/U10D, is to buffer the output of U6. If the inverters were not present it might present too much of a load on latch U6.

U9 is the current driver for the mechanical switches in the front end. These are open-collector outputs. A +18Vdc is applied to one end of the coils in the mechanical switches and U9 pulls the other end of the coil down to ground. All that is required for the 1 to 12.4 front end are the A and B outputs from U9 which are passed to terminal E9 through E12. The C and D outputs from U9 are passed to terminals E5 through E8 for future use.

3.3.2.4 Adjustments

There are four adjustments on the YIG driver CCA; one set (R16 and R21) is for the lowband YIG, the other set (R26 and R29) is for the high band YIG. Each set contains an offset and a gain control.

3.3.2.4.1 Low Band

R16 is adjusted to set offset current to the YIG filter; in other words this is adjusted when you are tuned to the low portion (1 GHz) of the band. R16 is used to center the filter at 1 GHz. For adjusting the high end of the band, R21 is adjusted when you are tuned to 4 GHz or 4.5 GHz-- depending on if you have the 1 to 12.4 GHz front end or the 1 to 4.5 GHz front end.

In aligning the low band YIG filter, you tune the controller to 1 GHz, adjust R16 to center the filter at 1 GHz and then tune the controller to 4 GHz and adjust R21 to center the filter at 4 GHz.

NOTE

When you are at the high end of the lowband, the software is setup so that you have to tune to 3.9999 GHz, otherwise when you tune to 4 GHz you will actually be in the low end of the highband. So to remain in the lowband you must remain within its limits.

3.3.2.4 High Band

The high band YIG filter uses R26 and R29. First you tune the controller for 4 GHz, then adjust R26 to center the YIG filter at 4 GHz and then tune the controller to 12.4 GHz and adjust R29 to center the filter at 12.4 GHz.

3.2.2.5 Front-End Assembly Differences

Differences and similarities between the 1 to 12.4 GHz, 1 to 4.5 GHz, and 4 to 12.4 GHz front-end assemblies can be seen by comparing Figures 6-4, 6-5, and 6-6. The similarity between all three front-ends is that they use the same dual YIG filter driver/logic controller. Note that only the functions of this driver/controller pertinent to a particular front-end are used for each front-end.

The principle differences are:

1. No coax switches are used in the 1-4.5 GHz and 4-12.4 GHz front-ends because these assemblies do not use low and high band paths for selecting the RF output.

2. The 1-4.5 GHz front-end circuit is almost identical to the low band path circuit for the 1-12.4 GHz front, whereas the 4-12.4 GHz front-end circuit is almost identical to the high band path for the 1-12.4 GHz front-end.

3.4 IF FREQUENCY AND LOCAL OSCILLATOR ARCHITECTURE

RF input frequencies are first converted to one of two IF frequencies by using a synthesized local oscillator. The first conversion IF frequencies are 4408/4409 MHz and 1964/1965 MHz. The first local oscillator (LO) conversion is accomplished using a single 4 to 8 GHz LO. When the receiver is tuned below 3 GHz, the 4409 MHz IF is used with the LO on the high side. When tuned between 3 and 6 GHz, the 1965 MHz IF is also used with a high side LO. From 6 to 9 GHz, the 1964 MHz IF is used with the LO on the low side. From 9 to 12.4 GHz, the 4408 MHz IF is used with the LO on the low side.

The selection of the two IF frequencies keeps the LO and image frequencies far away from the tuned frequency. This results in better rejection of image and LO frequencies and allows for wide band RF frequency coverage with a 4 to 8 GHz LO. The two IF frequencies are necessary to prevent RF feedthrough when the tuned RF input is equal to the IF frequency.

3.5 1ST LOCAL OSCILLATOR ASSEMBLY (A4) AND YIG ASSEMBLY (A2)

3.5.1 FUNCTIONAL DESCRIPTION

The 1st LO is comprised of two modules: the 1st LO synthesizer assembly and the YIG assembly. Together, these assemblies provide a synthesized LO which tunes with a 1 MHz step size. As with most microwave phase locked loop designs, a sample of the YIG oscillator output is downconverted to a lower frequency for processing in the phase lock loop operation.

The 1st LO assembly uses a 50 MHz crystal-generated reference signal, which is multiplied to a 200 MHz signal and then amplified to drive a step-recovery diode (SRD)/filter assembly. The output of the SRD/filter

assembly is a fixed frequency picket which is a multiple of 200 MHz in the range of 4200 MHz to 7800 MHz. The fixed picket signal is mixed with the YIG output sample to provide a downconverted IF signal between 100 and 300 MHz. This IF signal is then digitally divided to 1 MHz and fed to the phase detector loop circuitry.

The phase detector loop circuitry compares this 1 MHz signal to a reference 1 MHz frequency and generates the necessary correction signal to the YIG oscillator, via the oscillator FM coil input lines, to maintain a synthesized tuning step size of 1 MHz. The 1 MHz reference frequency allows the tuner to utilize a wide loop bandwidth, resulting in a low phase noise LO signal output with a 1 MHz resolution.

3.5.2 DETAILED DESCRIPTION

3.5.2.1 1st LO Synthesizer Assembly (A4)

This assembly consists of:

(1) 50-200 MHz Multiplier CCA (A4A1), PN 659732-001
(2) Divider CCA (A4A2), PN 659736-001
(3) Mixer module (A4A3), PN 659740-001
(4) Distribution CCA (A4A4), PN 659744-001

3.5.2.1.1 50-200 MHz Multiplier CCA (A4A1)

Refer to Figure 6-8, sheet 1 of 2.

A 50 MHz reference signal is connected from the reference multiplexer assembly (A1) to the 50-200 MHz multiplier CCA (A4A1), terminal E2, through connector J1 on this assembly. This CCA multiplies the 50 MHz input to a 200 MHz signal and amplifies it to a higher power level of approximately +25 dBm. The output of this CCA, at terminal E6, is connected to terminal E12 on the distribution CCA (A4A4) in this same assembly (see sheet 2 of 2).

The detailed operation of this card is as follows. The 50 MHz input is amplified by U1 and connected to frequency doubler U2. This 100 MHz signal then goes through a bandpass filter to remove any residual 50 MHz signal. C8 and C10 are trimmers to peak-up the bandpass response.

The output of the filter goes through amplifier U3 to boost the signal power level. U3 has a gain of between 15 to 20 dBm. The output of U3 goes to frequency doubler U4 to produce a 200 MHz signal that is input to another bandpass filter. C15 and C18 are trimmers to peak-up the bandpass response.

The 200 MHz must now be amplified to a minimum of +23 dBm to drive the SRDs (step-recovery-diodes) on the distribution CCA (A4A4). Amplifiers U5 and U6, which biased via components R4/L12 and R5/L14, are used for the first level of amplification. L12 and L14 are used primarily to keep the RF signal off the +5 Vdc power supply line and the resistance values of R4 and R5 set the amplifiers bias points. C19 and C22 are additional filters to keep the RF signals off of the +5 Vdc line.

Power divider U7 splits the 200 MHz signal into amplifiers U8 and U9. The reason for this is that one amplifier (MWA type) cannot achieve the required 18 dBm output power level by itself. But by combining the outputs of U8 and U9 in U10, an additional 3 dBm power output is achieved over the maximum power output which could be achieved by using U8 and U9 in series rather then in the parallel arrangement as represented by this design.

FB1 and FB2 are ferrite beads on the +5 Vdc line to aid in decoupling between the amplifiers that share this common power supply line. The values of the inductors and capacitors used in the aforementioned bandpass filters are very critical. Therefore, exact values must be used for any replacement components. Likewise, the physical placement of these components is also very critical.

Another function accomplished on this CCA (A4A1) is to generate a 160 MHz signal for internal test and calibration purposes within the tuner unit. This is done by tapping of the fairly strong 200 MHz signal at the output of amplifier U6 and connecting it to U11 (a divide-by-5 digital prescaler).

The output of U11 is a rectangular pulse at a fundamental frequency a 40 MHz which is used to drive an LC tank circuit. Since this is a "squarewave" pulse it contains many harmonics of 40 MHz. The components of the tank circuit were chosen to resonant at the fourth-harmonic of 40 MHz which is 160 MHz. C32 and L17 (the tank circuit) is lightly coupled to L19; L19 is a one turn loop of wire which goes over L17.

Q1 is used to turn-on and turn-off this 160 MHz calibration signal The base of Q1 is connected to terminal E5 which is part of the digital line to a controller which determines when this calibration signal is used. Resistors R10, R11, and R12 form an attenuator pad (approximately 6 dB) to buffer the 160 MHz output. The result is that the 160 MHz calibration signal is approximately -43 dBm out of J2.

3.5.2.1.2 Distribution CCA (A4A4) and Mixer Module (A4A3)

Refer to Figure 6-8, sheet 2 of 2.

The 200 MHz from the 50-200 MHz multiplier CCA (A4A1) comes into terminal E12 and is AC-coupled to diodes CR1-CR11 via capacitor C3.L1, L2, C1, C2, and R1 are power supply filters for blocking RF signals from the +5 Vdc line. These components are needed here since the 200 MHz signal line and +5 Vdc power line are being added together at the switching diodes CR1 through CR11. These diodes are turned-on and turned-off individually by a dc bias.

Control of diodes CR1 through CR11 is through a digital control word which is input, from the microprocessor, to terminals E2 through E5 and then to decoder U1. Note that only one diode is ever turned-on; the others remain in their off state.

The outputs from U1 are nominally in a "high" state, which back-biases the diodes and keeps them turned-off. When an output from U1

goes "low", it provides forward bias for its associated diode and the diode is turned-on. The "on" diode then permits the 200 MHz signal to pass through it. Note that each diode has an inductor on its control line to keep RF signals from going into U1. The series capacitor at the output of each diode removes the dc from the rest of the 200 MHz path.

The 200 MHz output from the turned-on diode goes to a SRD (step-recovery-diode). Operation of the SRDs (CR1 through CR11) in the frequency multiplier circuits requires a dc path. Potentiometers R2 through R12 provide this path. To adjust these potentiometers, you first peak-up the 200 MHz output on the 50-200 MHz multiplier CCA (A4A1), and then peak the output frequency of each cavity by adjusting R2 through R12.

The 200 MHz is applied to the selected SRD, which generates many harmonics of the 200 MHz (the 39th harmonic is the highest generated). Each SRD is air-coupled to a metallic rod which has a resonant characteristic at the desired output frequency from the cavity. This resonance enhances the desired harmonic while suppressing undesired harmonics. The resonant point is slightly adjustable by a variable capacitor (C6 through C16) which is actually a screw on top of the lid which covers the metallic rod structure.

Each resonant rod is air-coupled to a common pickup rod. The signal from the common pickup rod is the RF signal that is input to balanced mixer U1.

The purpose of the cavities is to generate these high frequency pickets to downconvert the YIG oscillator output to the 100 to 300 MHz IF signal which can be processed by the phase-lock-loop in the YIG assembly module (A2).

In summary the 50 MHz reference signal was converted to 200 MHz, and then the 200 MHz was converted into one of eleven fixed frequency pickets (4.2, 4.4, 5.0, 5.2, 5.8, 6.0, 6.6, 6.8, 7.4, 7.6, and 7.8 GHz) to mix in U1 with the input from the YIG oscillator which is step-tuned between 4 and 8 GHz. The resulting IF output is obtained from mixing the appropriate frequency picket with the YIG oscillator signal in the 100 to 300 MHz range.

The 100 to 300 MHz IF signal leaves this cavity section of the assembly and goes to RF amplifiers U2 and U3 to boost the signal level. The output of U3 is applied to terminal E10 on the divider CCA (A4A2); see the left side of sheet 1 of 2.

3.5.2.1.3 Divider CCA (A4A2)

Refer to figure 6-8, sheet 1 of 2, lower left side.

R13, R14, and R15 form a resistive pad to buffer the output of amplifier U3 to the input highpass filter (L5,C22, C23 and C25). The output of this filter goes to RF amplifiers (U9, U10, and U11) to boost the level of the IF signal. The output of U11 goes through a 6 dB pad (consisting of R16, R17, and R18) to buffer the IF signal. The output of the pad is connected to prescaler U8.

in the first L.O. module. Having the ability to reverse the polarity at the phase detector input, reduces the number of reference pickets needed for the first L.O. module.

Switch U3 is controlled by the microprocessor. The STROBE, CLOCK, and DATA lines go to latch U1 which converts the serial data into into parallel outputs. In this case, however, only a single output is necessary.

The phase/frequency detector (U4) generates an output signal on one of two lines, depending on whether the 1 MHz signal (input to pin 1) is slightly higher or slightly lower than the 1 MHz signal input to pin 3. These output lines are connected to op amp U6.

U4 produces pulses that are at a fixed voltage level but which have different pulse widths if the input signals are not equal in phase. This means the greater the phase difference between its input signals, the wider is the difference between the output pulse widths. The repetition rate of the outputs is the same as that for the reference signal.

Op amp U6 functions as a differential integrator. It integrates the pulse inputs and converts them to a dc level. This means that the wider the pulse at the input, the higher the dc level at the output of U6.

If one line is pulsing, indicating, for example, that the signal frequency is too low, this forces the output of U6 in one polarity direction. If the other line input to U6 is pulsing, indicating, for example, that the signal frequency is too high, this forces the output of U6 in another polarity direction.

The output of U6 is ideally a dc voltage which increases or decreases, depending on the relative phases of the two 1 MHz input signal to this CCA. This dc voltage is filtered to remove any harmonics which result from the pulses which are used to drive U6. Since the integration of the pulses cannot be perfect, the filter removes any ac ripples residing on the dc output of U6.

Capacitors C13 and C14 are trimmers. They are set by observing the output of the YIG oscillator. Ripples on the dc drive to the fine tune coil will be manifested as sidebands on the YIG output, at an offset of whatever frequency ripple appears on the dc.

The easiest way to set C13 and C14 is the first make sure that the YIG oscillator is phase-locked. Then, while observing the RF display, adjust C13 and C14 to minimize the sidebands at the outputs frequencies of the YIG oscillator. The worst case sidebands will appear at the loop reference frequency which, in this case, is 1 MHz. When these sidebands are minimized, C13 and C14 are set properly.

Op amp U7 is a high current device because greater than 100 mA is needed to produce the current drive for the fine tune coil. Device U5 is a voltage regulator which uses a -15 Vdc input to produce -5 Vdc at its output. This -5 Vdc is used as a bias voltage for the YIG oscillator.

Transistor Q1 and gate U2 are connected to phase detector U4 (pins 2 and 13) to monitor the phase lock condition. A TTL "low" on terminal E6 indicates a phase-lock condition. To understand how this circuitry works consider that when a phase lock condition does not exist, pulses are produced at pin 2 or 13 of U4. These are negative pulses which forward bias CR1. With CR1 conducting, Q1 is turned-on and the +5 Vdc connected to Q1's emitter is then connected to its collector and thus to E6, producing a -LOCK so the LOCK indicator signal is an active "low".

When there is a phase-lock condition, the input pulses at pins 2 and 13 of U4 are equal; consequently, no pulses appear at U2-3. Therefore, CR1 is not forward biased and C6 remains charged at +5 Vdc keeping Q1 turned off. When Q1 is not conducting, there is no current flowing in R18 and there exists a "low" locked-condition on the -LOCK line.

As regards the non-phase-lock condition, the unequal pulses coming from U2-3 allows CR1 to conduct part of the time. When CR1 is conducting, some of the charge is taken from C6 and Q1 conducts. In this case, Q1 will be in saturation, keeping the collector nearly at the +5 Vdc emitter voltage. This "high" voltage indicates a non-locked condition on the -LOCK line.

3.6 IF ASSEMBLY (A6, P/N 659905-001)

3.6.1 FUNCTIONAL DESCRIPTION

Refer to Figure 6-1, sheet 2 of 2.

The preselected RF input and the 1st LO signals converge at the first mixer on the IF assembly. When the 1st LO is tuned to produce one of the two IF frequencies, 4408 and 1964 MHz, the IF output from this mixer is passed through one of two 1st conversion bandpass filters by two SPDT switches.

Next, the IF signals are amplified by 10 dB to maintain good noise figure performance. The amplifier is then followed by a low pass filter to reduce harmonic mixing.

The 1st IF frequency is then converted to a secondary IF frequency using the 2nd LO. The third harmonic of the 2nd LO at a frequency of 3186 MHz lies directly between the two 1st IF frequencies and produces a single IF frequency of 1222 MHz. The 1222 MHz IF frequency passes through filters and an amplifier and arrives at the final conversion mixer. The 2nd LO frequency of 1062 MHz is used here to downconvert the 1222 MHz IF to the final IF frequency of 160 MHz.

Following the final conversion mixer is another amplifier whose function is to restore the signal gain. Note that the two LOs used in these conversions are harmonically related to each other. The 3186 MHz LO is the third harmonic of the 1062 MHz LO. To obtain these signals, the 2nd LO signal at 1062 MHz enters the IF assembly and is power divided and buffered. One of the resulting signals is tripled and amplified to become the LO for the 2nd conversion and the other signal is used as the LO for the 3rd conversion.

3.6.2 DETAILED DESCRIPTION

Refer to figure 6-12. Two different categories of signals come into this assembly; one category consists the RF signals from the front end assembly (A7); the other category consists of the local oscillator signal from the YIG assembly. Both signals are connected to the discrete mixer (U2) located in this assembly; the RF signals go to the R port and the L.O. signals go to the L port. The I port of the mixer is connected to a SPDT mechanical switch S1 through attenuator AT3.

S1 connects the resulting IF signals from the mixer to bandpass filters. FL1 is centered at 1964 MHz and FL2 is centered at 4408 MHz. The outputs of the filters are recombined in another SPDT mechanical switch, (S2) and then amplified by AR1.

Amplifier AR1 has a gain of approx 10 dB and maintains the dynamic range of the receiver. The output of AR1 goes through a tubular lowpass filter (FL3) having a cutoff frequency of 5000 MHz. For the -003 version of this assembly a 2500 MHz lowpass filter is added to accommodate the 4-12.4 GHz and 1-12.4 GHz front ends. The filter is added between switch S1 and filter FL1.

Attenuator pads AT1, AT2, and AT3 are factory selected. AT3 matches the output of U2 to the input of S1; AT2 matches the output of S2 to the input of AR1, and AT1 matches the output of AR1 to the input of FL3. All three pads improve the gain flatness of the circuit. Unwanted ripples would occur if these pads were not present.

The output of FL3 is connected to the R-port of mixer U1. The input to the L-port of the mixer is a 3.186 GHz signal that comes from the tripled 1.062 GHz second L.O. The IF output of the mixer, centered at 1.222 GHz, is cabled to a housing where further filtering, amplification and another downconversion are performed.

The filters in A6A3 are micro-strip types with tuning capacitors (C1 and C2) accessible thru the rear side of the assembly. The tuning capacitors are used to set the bandwidth and flatness of the filters. There is one stage of filtering and then an amplification stage. The amplifier has approximately 10 dB of gain.

After the amplifier is another filter (which is identical to the filter that is at the input to amplifier). Capacitors C3 and C4 are used to adjust the bandwidth. These are factory-set and should not require adjustment in the field. Both filter stages and the amplifier are on one CCA. If there is failure of any components, the entire CCA should replaced.

After the bandpass filter/amplifier/bandpass filter stages, the signal goes to a the R-port of a balanced mixer in module A6A4 where a second downconversion is performed to produce a 160 MHz signal at the I-port of the mixer. The input to the L-port of the mixer comes from the 1.062 GHz L.O. output of the second L.O. synthesizer assembly (A3) through a power divider and an amplifier. Thus, we have 1.222 GHz mixing with 1.062 GHz to obtain the final IF of 160 MHz.

There is a micro-strip tuning stub at the I-port of the mixer U1 on the second downconverter module (A6A4). This stub is used to attenuate the 1.062 GHz L.O. signal so that it does not get into the amplification in the subsequent stages. The stub is printed and not adjustable. Following the stub is an IF amplifier.

There is a built-in test port in this circuit. It can be used for testing the amplifier to ensure that the final stage of amplification is good. It can also be used as a future enhancement for calibrating the tuner for input levels. Resistors R1, R2, R3 isolate the IF from the calibration tone. This resistive network allows injection of the tone into the signal without disrupting the VSWR of the micro-strip line.

3.6.2.1 Second L.O. Driver (A6A6)

This module provides the two L.O. signals required for each conversion process in the IF assembly (A6). One signal is the 1.062 GHz and the other is the 3.186 GHz. These signals are harmonically related; the 3.186 GHz is the 3rd harmonic of the 1.062 GHz signal.

The fundamental 1.062 GHz signal comes from the second L.O. synthesizer assembly (A3). A power divider splits this input; one output goes through amplifier to mixer U1 on the second downconverter module (A6A4); the other output is amplified, tripled in frequency, combline filtered and applied to the 3187.5 MHz amplifier A6A5.

The power divider area has capacitors, a resistor, and very thin traces (7.5 nanohenries) which act as inductors. This circuitry appears as a resonant tank-circuit at 1.062 GHz. So this is the tuning for the input as well as a power divider.

Each output of the power divider has two stages of amplification (U1/U2 and U3/U4). The first amplifier in each output has an approximate gain of 10 dB; the second amplifier has an approximate 1 dB gain.

Filters FL7 and FL8, shown connected to E1 and E2, are simply feed-thru capacitors acting as lowpass filters to prevent high frequency noise from getting into the circuitry. Q1 is used to generate a 6.5 Vdc to provide bias to the U1 through U4 amplifiers. Notice that the bias is applied at the output stage of the amplifiers. This is how they get their dc to operate. Inductors L1 through L4 pass the dc to the amplifier and yet act as high impedance for the signal (the ac).

The resistors act as voltage dividing networks. This is necessary since the GPD420-type amplifiers require 2.8 Vdc for operation while the GPD430 types require 5 Vdc. The resistors allow a voltage to drop across them instead of applying the full voltage to the amplifiers.

The output of amplifier U2 goes to the tripler which generates the 3rd harmonic (3.186 GHz) of the 1.062 GHz input. The step-recovery diode and tank circuit consisting of L1 and C9 produce the 3.186 GHz signal. The output is through a 1/4 wave stub and goes to a combline filter arrangement. The 1/4 wave stub and L1 are merely a pieces of bus-wire.

The combline filter is a three-section device. C1, C2, and C3 adjust the filter. These capacitors are tuning slugs accessed through the side of the housing. They simply adjust the air-gap between the slug and the edge of the tuning rod. Once set in the factory they should not require re-adjustment in the field. The slugs have a locking-type friction thread that will not turn under vibration.

The output of the 3-section combline filter is hard-wired, with bus wire, directly on to the micro-strip on the amplifier module (A6A5). This is soldered directly from the output tuning rod directly down on microstrip. The amplifier simply amplifies the 3.186 GHz L.O. and filters out any feed-through of the 1.062 MHz.

3.6.2.2 3187.5 MHz Amplifier (A6A5)

This module amplifies the 3.186 GHz signal and filters out any interfering 1.062 GHz signal if it happens to feed through. Two stages of amplification are used--Q1 and Q2, which are microwave transistors. Q3 and Q4 are current sources and provide bias for the Q1 and Q2. C6 and C8 couple the ac portion of the 3.186 GHz signal in from the microstrip and decouple any dc. The dc appears at the base Q1 and at the input to module A6A5. These traces are grounded so the base would be dc-grounded without the capacitors and likewise at the output.

3.6.2.3 Coax Switch Driver (A6A1)

This very simple circuit, consisting of switch driver U1 and inverter U2, enables the IF SELECT signal from the microprocessor to control the selection of bandpass filters FL1 or FL2 through coax switches S1 and S2. The input to S1 is the IF output of mixer U2. Recall that the LO input to U2, from the 1st LO assembly, can be tuned to produce an IF output of U2 at either 1964 MHz or 4408 MHz.

Assume that the IF SELECT signal is high. This means that the two inputs to the first and third NAND gates in U1 are high. The outputs of these gates are therefore low and the first and third transistors are turned off.

With IF SELECT high, the two inputs to the second and fourth NAND gates in U1 are high and low (the low input is the IF SELECT signal inverted by U2 and the high input is the +5V Vcc input through the buffer). This means that the outputs of the second and fourth NAND gates are high, turning on the second and fourth transistors which grounds the bottom pin 1 of coax switch S1 and the bottom pin 2 of coax switch S2. This means that filter FL1 is selected and that the IF output of mixer U2 is 1964 MHz.

Assume that the IF SELECT signal is low. This means that the outputs of the first and third NAND gates are high, turning on the first and third transistors which grounds the bottom pin 2 of S1 and the bottom pin 1 of S2. Therefore, filter FL2 is selected and the IF output of mixer U2 is 4408 MHz.

3.7 SECOND LOCAL OSCILLATOR ASSEMBLY (A3)

3.7.1 FUNCTIONAL DESCRIPTION

The 2nd LO signal is a variable RF signal near 1062 MHz. The 2nd LO tunes in 250 Hz steps and increases the tuner resolution from 1 MHz, with the 1st LO, to 1 kHz. Because the 2nd LO is utilized twice in the conversion process (once after being tripled) its 250 Hz resolution is effectively quadrupled to 1 kHz.

The 2nd LO utilizes a dual loop design. While more complex than single-loop phase lock loop (PLL) designs, the 2nd LO provides fine resolution (250 Hz) while maintaining high quality phase noise comparable to single-loop PLL designs using much larger step sizes.

The 2nd LO main (output) loop is a very simple, non-programmable loop which locks the 1062 MHz output VCO to a 12 MHz reference signal. The VCO output is mixed with a fixed 1050 MHz crystal-generated reference to obtain the 12 MHz needed for phase comparison at the phase detector input. With the high reference frequency, a wide loop bandwidth can be utilized to minimize phase noise at the output. The reference loop itself tunes from 128 to 160 MHz in 16 kHz steps. Normally such a small step size portends poor phase noise performance, but since the output frequency is low this is not a problem.

Phase noise is further reduced, and resolution increased to 250 Hz steps, by first passing the reference through a fixed divide-by-64 IC. This signal (approximately 2 MHz) is upconverted with a 10 MHz signal to provide the 12 MHz reference to the main loop, transferring its 250 Hz resolution to the 2nd LO output.

3.7.2 DETAILED DESCRIPTION

This assembly contains seven CCAs:

1. Resolution Loop Amplifier (A3A1)
2. Resolution Loop Mixer (A3A2)
3. Resolution Loop Assembly (A3A3)
4. Translation Loop VCO (A3A4)
5. Translation Loop Mixer (A3A5)
6. Translation Loop Phase Detector (A3A6)
7. 50-1050 MHz Multiplier (A3A7)

The detailed theory of operation is presented in a manner which permits the reader to follow signal flow in the most logical way. Figure 6-13 (two sheets) is the detailed schematic diagram for all CCAs in this module.

The overall purpose of the second L.O. module is to provide a 1062 to 1063 MHz signal to the IF assembly (A6) in 250 Hz step sizes.

3.7.2.1 Translation Loop VCO (A3A4)

Refer to figure 6-13, sheet 2 of 2. This CCA generates the output 1062-1063 MHz signal. Transistor Q1 and components C4, DL1, C2 and

C3 form the basic oscillator circuitry. Delay line DL1 is a length of transmission line which is resonant at the sub-harmonic of the desired outputfrequency. By slight tuning of C3 the oscillation is forced at the appropriate harmonic near 1062 MHz. This oscillator is then phase-locked through the tuning line which is connected to terminal E1.

CR1, a varactor, is used to provide the fine-tuning needed for phase locking the VCO by using the dc correction voltage output of the differential integrator/amplifier U4 on CCA-A3A6. The way this correction voltage is developed is discussed in a subsequent sub-section devoted to the operation of CCA/A3A6.

The output of Q1, at its collector, goes through an attenuator pad (R6, R7, and R8) which buffers the output from amplifier U1. U1 provides 10 dBm signal level at connector J3. The output from J3 is connected to IF assembly A6.

To obtain phase-locking capabilities, a portion of the signal from the VCO is coupled, via a CCA coupler design, to terminal E2. E2 is connected to terminal E1 on CCA/A3A5. The signal at this point is approximately -10 dB.

3.7.2.2 Translation Loop Mixer (A3A5)

The design of this CCA is very simple. It takes the signal sample from the VCO on CCA/A3A4, amplifies it through U1 and U2 and then down-converts it, from the nominal 1062 MHz, to approximately 12 MHz to 13 MHz via mixer U3. This down-conversion is accomplished by injecting a fixed 1050 MHz signal, from CCA/A3A7, into the RF-port of U3.

The output of U3 goes through a 3 dB attenuator pad (R3, R4, and R5) to provide buffering and impedance matching for the output of the mixer which is connected to CCA/A3A6. This aids in stabilizing the overall operation of this synthesizer assembly. The output of U3 is an IF signal between 12 MHz and 13 MHz, which is the down-converted sample of the 1062-1063 MHz. This IF is then used to phase-lock the VCO signal. The output from U3 is connected to terminal E4 on CCA/A3A6.

3.7.2.3 50-1050 MHz Multiplier (A3A7)

This CCA generates the 1050 MHz output to CCA/A3A5 via an amplifier/multiplier chain. The input to CCA/A3A7 is a 50 MHz reference signal from the reference/multiplexer assembly (A1); refer to the tuner functional block diagram (Figure 6-1).

The 50 MHz input is amplified by RF amplifiers U1 and U2, then lowpass filtered (by C4 and L1) and then injected into step-recovery diode (SRD) CR1. CR1 generates multiples of the 50 MHz input; one of which is the desired 1050 MHz signal (this is the 21st harmonic of 50 MHz). The output of CR1 passes through a stripline filter which is tuned precisely to 1050 MHz. This means there is very strong coupling at 1050 MHz but a very strong rejection of other harmonics developed by CR1.

The tuning of the stripline filter is optimized by adjusting C6, C7, and C8. This adjustment is best performed with the aid of a spectrum analyzer attached to the 1050 MHz test point (J4). Three stages of filtering are required to obtain sufficient rejection of the other harmonics generated by CR1 so that they cannot interfere with the operation of the phase-lock loop process.

Components R6, R8, and R9 form a pad to buffer the test point and prevent interference with the basic operation of the amplifier/multiplier circuitry. The values of R5 and R7 were determined experimentally to be an optimum means for impedance matching the output of the stripline filter into mixer U3 on CCA/A3A5.

3.7.2.4. Translation Loop Phase Detector (A3A6)

This CCA receives the 12-13 MHz IF signal, from mixer U3 and an attenuator pad on CCA/A3A5, at terminal E4. This signal is lowpass filtered by C9, C10, and L1 to reduce extraneous spurs. U3 provides amplification and buffering of the signal.

Transistor Q3 essentially provides a level-shift to take what is an ac-coupled signal and shift it to a positive voltage range for compatibility with the ICs on this CCA. In effect, it converts the ac signal to a TTL-level signal.

The output of Q3 goes to phase-detector U2 (pin-9). Resistors R37 and R38 convert the TTL-level signal from Q3 to an ECL-level to make it compatible with U2.

The other input to U2 is also a 12-13 MHz signal which is generated by the CCAs shown schematically on sheet 1 of 2. (Operation of these CCAs is discussed in the paragraphs concerning CCAs A3A1, A3A2, and A3A3.) This signal is used as the reference frequency for the phase lock process.

The two input signals to U2 are compared and any phase or frequency difference is detected as an error in the IF signal (derived from the 1062-1063 MHz VCO). As a result of any phase or frequency input difference, U2 produces an appropriate correction signal (negative-going pulses) at either pin-11 or pin-4 (depending on whether the IF frequency/phase is too high or too low).

The resulting correction pulses go to differential integrator/ amplifier U4. Since U4 is an integrator, it converts the input pulses to a dc-level which indicates the amount of error in the two signals. This dc output then goes to terminal E5 which is connected to terminal E1 on CCA/A3A4. From E1 it goes to CR1 in the VCO tuning line.

Varactor CR1 (on A3A4) is part of the fine-tuning feedback loop for the VCO circuit. By varying the dc correction voltage output by U4 the capacitance of CR1 is changed, thereby varying the capacitance in the feedback loop and making the necessary phase/frequency correction for the VCO.

The feedback loop originates from the emitter of Q1, through DL1, to ground, and then to the anode of CR1. By varying the capacitance of CR1, the resonant frequency of the VCO is slightly tuned to ensure its desired output.

The output of U4, at terminal E5 on CCA/A3A6, is also connected to two sections of dual-voltage comparator U1. The function of U1 is to detect a negative or large positive voltage level which indicates if the phase-lock loop has lost its "lock". If the output of U4 is negative or at the positive rail, one of the outputs of U1 will be low. The outputs are summed together through CR2 through CR5. One of the outputs of U1 will be "low" if the loop has lost lock, while the outputs are "high" if the loop is in lock. The signal is coupled from terminal E2 to terminal E16 on CCA/A3A3 (see the right side of sheet 1 of 2).

This method of "lock indication" is different than that used in the first L.O. synthesizer assembly (A4). In this case, phase detector U2 operates at a much higher reference frequency and is an ECL device. So the magnitude of the pulses is lower then that used with the phase detector in assembly A4 where the phase detector used TTL-level pulses. Therefore it would be more difficult to accurately detect and decode pulses unless this method is used.

Referring to the middle left of sheet 2 of 2, locate Q4 and U5. These two devices comprise a voltage regulator circuit which uses a -15 Vdc input and generates a -11 Vdc output which goes to CCA/A3A4 where it is used for biasing Q1.

Before concluding this discussion of CCA/A3A6, note that in the previously described phase-lock loop there are no programmable dividers. This means there is, inherently, no step-size provided by this loop; yet, a 250 Hz step-size must be provided at the output. To accomplish this step-size the 12-13 MHz reference signal (connected to CCA/A3A) contains the 250 Hz step-size. This reference signal is generated by CCAs A3A1, A3A2, and A3A3. Generation of this signal begins with A3A3, so this is the next CCA discussed.

3.7.2.5 Resolution Loop Assembly (A3A3)

Refer to sheet 1 of 2, the lower right side. U6 is a voltage-controlled oscillator (VCO) which is tunable between 128-196 MHz. It is supplied with a slightly regulated and filtered +15 Vdc through Q1, C14, R29, and C21 which help minimize power supply noise.

The output of U6 goes to power-splitter U5 which divides this signal into two paths. One path goes through a buffering pad (R26 through R28) and then to CCA/A3A2; the other path goes through a buffering pad (R22 through R24) to U4 which is a variable modulus prescaler capable of dividing by either 64 or 65. U4 is used with U2 (a self-contained phase-lock loop IC, containing programmable dividers, a phase detector, and associated circuits). U2, combined with U4, provides most components in a phase-lock loop to provide a 16 kHz tuning step-size that is phase-locked to a 10 MHz reference input.

The 10 MHz reference signal, connected to J1, is provided by the reference/multiplexer assembly (A1). After entering CCA/A3A3 at terminal E15, the signal is power-divided by U1. One path from U1 goes to U1 on CCA/A3A2; the other path is to U2-1, through a buffer pad (R1 through R3).

The outputs of U2 (at pins 15 and 16) are pulses which indicate if the loop is locked to the desired frequency--or not locked. The pulses function very similar to those described for the phase-loop discussed in the operation of the first L.O. synthesizer (A4).

The desired frequencies to be phase-locked are programmed into U2, by the tuner microprocessor, through the 2ND LO DATA line and the other two microprocessor lines (2ND LO STROBE and 2ND LO CLOCK). The output pulses from U2 go to differential integrator/amplifier U3. The gain balance, between the "too high" and the "too low" pulses, can be optimized by adjusting R10 which changes the gain of the output pulses at U2-16.

U3 converts the pulses from U2 to a dc-level error voltage which is lowpass filtered (by C11 through C13 and R18 through R20) to eliminate spurious signals generated in U2. CR1 prevents any negative-going voltage from going to U6, since this VCO is susceptible to ceasing oscillations if there is any negative input voltage. If it stops oscillating it is possible for the loop to lose "capture" and thereby stop functioning.

The loop-correction voltage is then applied to the tuning coil of U6. This completes the phase-lock loop.

U7, which is schematically located near U2, is a voltage regulator which supplies a "clean" +5 Vdc input to U2. This +5 Vdc is derived from a +15 Vdc input to U7.

Referring to U2-7, note the output, through CR1, to the "LK" line. This is the phase-lock indicator for this loop. This output is summed together, through CR1, with the lock indication which was generated on CCA/A3A6. The sum of these two phase-lock signals is then provided as an output from assembly A3. This means that this phase-lock loop and the previously described phase-lock loop must be locked before assembly A3 produces a phase-lock indication.

With the completion of this phase-lock process, a 128-196 MHz signal (with a 16 kHz step-size) has been generated. We now discuss the other path of the VCO (U6) output through power-splitter U5.

3.7.2.6 Resolution Loop Mixer (A3A2)

The 128-196 MHz signal from U6 on CCA/A3A3 (via U5) enters this CCA through terminal E4 and goes to U3 (which is a fixed divide-by-64) digital divider. R12 and C14 are used because U3 is an ECL-type prescaler and this requires ac-coupling. Note there are very narrow dynamic ranges present and dc shifts or offsets, from other circuits, and these must be minimized to ensure proper operation.

The output of U3 is a TTL-level signal with an approximate 2-3 MHz center frequency, having a 250 Hz step-size (16 KHz step-size divided by 64). This signal is then bandpass filtered by the following three stages of LC filtering. The values of these components are not absolutely critical, but if they must be replaced, select appropriate values consistent with their ±tolerance values.

At this point the signal has the right step-size (250 Hz) but it is too low in frequency because now there is a center frequency between 2 and 3 MHz; therefore, the signal must be upconverted. This upconversion is implemented with mixer U2 by mixing this signal with a 10 MHz signal from the reference/multiplexer assembly (A1). This is the signal that was power divided by U1 on CCA/A3A3.

The 10 MHz signal goes from terminal E3 to U1 which provides amplification and buffering. The output of U1 goes to the LO-port of mixer U2 through an impedance matching pad (R2 through R4). The 10 MHz signal is then mixed with the 2-3 MHz signal at the RF-port to produce a 12-13 MHz signal output at the IF-port. This IF signal preserves the step-size of 250 Hz of the 2-3 MHz signal.

The pad consisting of R5 through R7 provides impedance matching with amplifier/buffer U1 contained on CCA/A3A1.

3.7.2.7 Resolution Loop Amplifier (A3A1)

Functionally, this is a very simple CCA. U1 provides the amplification necessary to make up for the mixing and pad losses in signal level which has occurred in the loop. The output of U1 is terminated by a dB pad (R2 through R4) and then goes through five sections of bandpass filtering (centered about a 12-13 MHz frequency range). The components in the filter chain are not very critical, but if replacement is required the values should have a tolerance of ±5%.

The output of the bandpass filter goes to amplifier U2 through a buffer pad (R5 through R7). The output of U2 is the 12-13 MHz signal (with the 250 Hz step-size). From terminal E3 the signal is then connected to terminal E3 on CCA/A3A6 where it is used as the reference input to the phase-lock loop.

3.7.2.8 Step-Size Resolution

The step-size of 250 Hz is generated in two places. On CCA/A3A3, the phase-lock circuitry (because of the programmable dividers and comparators in PLL chip U2) generates a signal with a 16 kHz step-size. But this signal is centered about a frequency range of 128-196 MHz. CCA/A3A3 outputs this signal to CCA/A3A2 where the signal is divided by 64 in U3. Because the input signal contains frequencies which can be tuned in increments of 16 kHz, and because U3 divides by 64, the effective output is 2-3 MHz with a step-to-step change of just 250 Hz.

3.8 REFERENCE/MULTIPLEXER MODULE (A1), P/N 659899-001

3.8.1 FUNCTIONAL DESCRIPTION

The remaining module in the RF tuner is the reference/multiplexer module. The reference/multiplexer module serves two purposes. First, the module contains a 50 MHz reference crystal oscillator which is used to generate all the reference frequencies for the tuner's oscillators. The 50 MHz oscillator is itself phase locked to the 10 MHz reference oscillator located in the IFC reference/multiplexer module.

Power and frequency divider circuits in the reference generator module provide two 50 MHz signals, one 10 MHz signal and one 1 MHz reference signal required by the tuner's phase locked loops. The reference/multiplexer module's other function is to frequency multiplex the tuner's IF frequency, the receiver's 10 MHz reference signal and half duplex data from and to the IFC unit onto a single 50 ohm coaxial cable.

The reference/multiplexer module can drive up to 300 feet of cable with a maximum insertion loss of 10 dB at 160 MHz. The single cable receiver interconnection is a unique feature which is particularly useful for situations where the tuner is to be remotely located from the IFC unit and eliminates the need for large bundles of cables in the receiving system.

3.8.2 DETAILED DESCRIPTION

This assembly contains five CCAs:

50 MHz Oscillator (A1A1)
50 MHz Phase Lock Loop (A1A2)
160 MHz Line Drive (A1A3)
10 MHz Filter (A1A4)
Controller Logic (A1A5)

Refer to Figure 6-14, sheet 1 of 2. The 160 MHz IF from the line driver/amplifier in the tuner's IF module (A6) comes in to connector J6 (middle top of the schematic). It goes through the current-controlled variable attenuator U1, is power amplified by U2, and then is filtered by the high-pass filter consisting of C6, C7, C8, L3, and L4. This filter passes signals above 100 MHz.

The half-duplex data from the microprocessor is filtered by the filter located on the serial filter data board and goes to connector J7. The filter consists of L1 through L3 and C12 through C14.

The 10 MHz reference signal is tapped off connector J7 and goes through a 10 MHz low-pass/bandpass filter consisting of L3 through L5 and C5 through C9. The signal is then amplified by U2 and U1 and goes to pin E4 on board A1A2 (see sheet 2 of 2) located on A1A4. The components at the outputs of U2 and U1 are for biasing and RFI filtering.

On the left side of figure 6-14, sheet 1 of 2, is the voltage-to-current converter to control the the attenuation of attenuator U1 on

A1A3. U1 is a current-controlled attenuator. The circuit receives a 0-10 Vdc attenuation control voltage from the microprocessor at connector J8 which is wired to terminal E1 on CCA/ A1A5. Attenuator U1 is a more linear device when it is current-operated. By using this method of current drive the attenuator is not effected by changes in temperature.

CR1, CR2, R1, R2, and R3 form a voltage shaping network to accommodate any non-linearities of attenuation versus control voltage. The combination of Q1, Q2, U1A, and U1B form a constant-current driver for U1. This improves stability with temperature changes. Q1 is the pass transistor.

U1B combined with Q2 forms a current loop so that the current through R12 and R13 is equal to the current through R8 and R9 which are in series with U1 on A1A3. This is so that the current can be monitored and compared with the control voltage input to U1A. U1A controls the operation of Q1.

The current is maintained through R12 and R13 by U1B, which compares the current through R8 and R9. The feedback loop, including Q2 and the op amp is stable when the differential voltage to the input of the op amp is zero. This means there is equal current through R8 and R9. The conduction of Q2 is controlled by U1B. All the current that flows through Q2 flows through R12 and R13.

CR3 prevents reverse current from going through Q2. R11 ensures that Q2 turns-off. C4 and C5 help stabilize the loop. R5 turns off Q1. R6 limits the current driving Q1. R4 stabilizes the input impedance.

R13 is adjusted if the desired output of the attenuator does not track the input control voltage appearing at terminal E1. A certain input voltage should produce a certain amount of attenuation in U1. If this does not occur, then adjust R13 until both the control voltage and attenuation track each other.

The LC circuits after connectors E2 and E3 (at the inputs to U1) are RFI filters to prevent unwanted RF leakage on the 160 MHz board to come back into board A1A5 and vice-versa. For example, any switching signal that might be on the switching power supply could get on to the voltage line and would modulate the control voltage to produce an amplitude modulation of the signal.

Refer to Figure 6-14, sheet 2 of 2 (middle bottom of schematic). The 10 MHz input comes from pin E of A1A4. The U1 devices are inverters. U1B is used to square the signal. A sine wave comes in on E3 and it must be a square wave for proper operation of the phase-locked loop (PLL). U1A is used as a buffer. U1C inverts the signal to a logic level required for proper operation of U2B.

U2A and U2B are decade counters functioning as divide by 10 devices. The input to U2B is a 10 MHz signal and its output, which goes to U4-9, is a 1 MHz signal.

U4 is a PLL chip (with a divide by N device in its feedback loop). In this case, we're dividing by 4 and phase detecting it. The output of U4-13 is an analog voltage which goes through a loop filter on the 50 MHz oscillator board (A1A1). This loop filter consists of U4 (on A1A2) and associated circuitry on A1A1.

The 50 MHz signal output from pin E5 on the 50 MHz board (A1A1) is connected to E7 on the 50 MHz PLL board (A1A2). It is buffered by Q1 (on board A1A2) which is also used as a level shifter to shift the signal into an acceptable level for U3.

U3 is a synchronous counter used as a divide by 5 counter. It uses the 50 MHz signal to produce a 10 MHz output at E1. U1A buffers and inverts this 10 MHz signal. U3 also supplies a 10 MHz signal to U2A (which is a divide by 10 counter) to produce a 1 MHz signal. This 1 MHz signal goes to the 1 MHz outputs at E3 and E2 through inverters U1D and U1E.

The 1 MHz signal also goes to U4-1 where it is used for pulse width modulation. U4 compares the 1 MHz signal at pin-1 with the 1 MHz signal at pin-9. If the two 1 MHz signals have a phase and frequency difference, a pulse output from U4-13 is sent to the inverting terminal (U4-2) of the op amp comparator U4 on the 50 MHz oscillator board to enable this op amp to provide voltage drive for the 50 MHz oscillator and thus null the phase-lock loop error.

The farther in phase and frequency that the two 1 MHz signals are from each other, the wider the pulse is that is produced by U4-13 on board A1A2. When the two 1 MHz signals have no phase or frequency difference, the loop is phase-locked and there is a constant dc output from U4-13.

U4 on the 50 MHz oscillator board (A1A1) is used to filter the pulse-width modulated signal and feed it back into the control voltage coil of the temperature-compensated crystal U1. U4 is a ultra low noise precision op amp. This provides low phase noise for the phase locked loop.

The external components for U4 are to establish its performance parameters. The signal level input to U4-2 varies 0 to 5 volts. A zero volt input to crystal oscillator U1 enables U1 to be right at its center frequency. Since U1 is a negative-slope crystal, the more positive the tuning voltage, the more the frequency will go below 50 MHz and vice-versa.

The summing point of U4 is the inverting terminal which then causes a dc offset to be produced at U4-6. The input at U4-2 is the 0 to 5 volt signal from the U4-13 (board A1A2) and the output of op amp U4-6 (on board A1A1) needs to be a bi-directional signal that is centered around zero volts.

U2 and U3 on the 50 MHz oscillator board (A1A1) are 3 dB power splitters. U2 splits the 50 MHz signal output from U1 and sends it to U3 and connector E3. U3 splits its 50 MHz inputs and sends it to connector E4 and buffer amplifier Q1. The 50 MHz signal at connector E3 is 3 dBm less in power then the 50 MHz output at E4.

3.9 VOLTAGE REGULATOR (A10), P/N 659846-001

Refer to figure 6-15. This board receives +8 Vdc, +18 Vdc, and -18 Vdc from the tuner's dc power supply and provides regulated +5 Vdc, +15 Vdc, and -15Vdc outputs to the various boards and modules within the tuner. Test points are located on the board to enable checking the three input and output voltages.

The three regulators are activated when the ACT signal at J1-1 is high (+2.5 Vdc) and de-activated when the ACT signal is low (0 Vdc). Signal ACT is controlled by the tuner's microprocessor.

The activate circuit functions as follows. Q1, Q2, Q4, and Q5 are transistor switches. When ACT is high, Q1 conducts and effectively connects ground potential to the bases of Q2 and Q4, turning off these transistors. This means that +5 Vdc and +15 Vdc appear at J1-7 and J1-4 respectively. The +15 Vdc at J1-4 is also connected to the base of Q5 and turns off this transistor. This activates the negative voltage regulator circuit and -15 Vdc appears at J1-5.

3.9.1 POSITIVE OUTPUT VOLTAGE REGULATION

Components U1 and U2 are 3-terminal positive voltage regulators (type LM 350) capable of supplying in excess of 3-amps. U1 is fixed for a +5 Vdc output and U2 is fixed for a +15 Vdc output.

Capacitors C2 and C4 are used to improve the transient response of the circuits. Capacitors C1 and C3 are filter capacitors. CR1 and CR2 are used as protection diodes to prevent the capacitors from discharging through low current points into the regulators. Resistors R1 through R6 and R8 through R10 are used to establish the bias points of transistors Q1, Q2, and Q4.

3.9.2 NEGATIVE OUTPUT VOLTAGE REGULATION

U3 is a 3-terminal negative voltage regulator (type LM337T) capable of supplying 1.5 amperes. It is fixed for a -15 Vdc output.

Resistors R14 and R15 set the fixed output voltage. Capacitors C5 and C6 improve the transient response of the circuit. CR3 and CR4 are protection diodes to prevent the capacitors from discharging through the low current points into the regulator.

3.10 POWER SUPPLY ASSEMBLY

The power supply is a switching-type that operates from 115/230 Vac, 47 to 400 Hz single-phase input power. The outputs are a regulated +8 Vdc and regulated +18 Vdc and -18 Vdc.

The ac input to the tuner is passed through the line filter board to assist in meeting RFI/EMI standards. The power supply outputs are routed to a separate dc regulator board that supplies the majority of tuner modules

with their dc voltages. The purpose of the separate regulator board is to allow the microprocessor to turn the dc regulators on or off a with TTL command.

The power on/off feature enables the RF tuner, when remotely mounted, to be powered down and placed into a stand-by mode when not in use. The switching frequency of the power supply is 96 kHz. Because the power supply switching frequency is outside the loop bandwidth of the RF tuner's local oscillators, the switching frequency signals are easily filtered with conventional dc feedthrough and decoupling filters.

The power supply assembly is not repairable in the field.

3.11 FRONT PANEL LED ASSEMBLY (A11)

Figure 6-16 is the schematic for this assembly. The assembly contains the front panel STANDBY and ACTIVE light-emitting-diodes (LEDs) CR1 and CR2. VR1 is used for regulating the input +8 Vdc to +5 Vdc. R1 and R2 are current limiting resistors and C1 and C2 are decoupling capacitors. When the tuner is placed in the "active mode", the ACTIVE signal at terminal E1 is "high" and CR2 is lighted. When the tuner is placed in the "standby mode", the ACTIVE signal is "low" and CR1 is lighted.

SECTION IV

MAINTENANCE

4.1 GENERAL

The WJ-8969/TUXXXX Tuner units have been designed to operate for extended periods of time with minimum routine maintenance. Inspection and performance tests should be conducted at regular intervals consistent with the facility's normal scheduling and after troubleshooting. No routine adjustments are required. Troubleshooting and performance tests can be most effectively carried out if the technician first familiarizes himself with the operating instructions and circuit descriptions in Sections II and III, respectively. Parts lists and component location diagrams are in Section V.

4.2 INSPECTION FOR DAMAGE OR WEAR

Many potential or existing troubles can be detected by making a visual inspection of the unit. For this reason, a complete visual inspection should be made on a regular basis and whenever the unit is inoperative. Components showing signs of deterioration should be checked and a thorough investigation of the associated circuitry should be made to verify proper operation. Damage due to overheating may be the result of other less apparent troubles in the circuit. It is essential that the cause of overheating be determined and corrected before replacing the damaged parts. Mechanical parts such as pin connectors and chassis wiring should be inspected for excessive wear, looseness, misalignment, corrosion, and other signs of deterioration.

4.3 COMPONENT LOCATION

Every component in the receiver can be located by using the component location diagrams found in Section V. The component location diagrams are listed according to their reference designation prefix and can be found using the List of Illustrations in the front of the manual. The top covers on the unit also show module locations. For further instruction on reference designations, see paragraph 5.1.

Note

The first ten Tuner units (serial numbers 1 through 10) were physically configured with the 1st LO module A4 (659903-001) underneath the 2nd LO module A3 (659901-001) and the IF module A6 (659905-001). Product improvement of the Tuner unit required that the 1st LO module be located above the IF module, with the 2nd LO module below the IF module. This is now the physical configuration for Tuner units with serial number 11 and beyond.

4.4 REPAIR

When a malfunction has been isolated to a specific circuit board or assembly, the user may decide to make the repair or replace the CCA or assembly with a spare. All of the modules can be removed entirely.

4.5 PREVENTIVE MAINTENANCE

This unit is designed to operate for extended periods of time with minimum maintenance. Normally, the only preventive maintenance tasks to consider are:

1. Clean the unit.
2. Inspect the outside and inside of the unit for physically worn, damaged, loose, or overheated parts.
3. Perform a performance check of the unit.

If the equipment is used in an environment where a great deal of dust, high temperature, or high humidity is present, the frequency of the checks should be increased. Table 4-1 provides the maximum time intervals between equipment cleaning and performance checks.

Table 4-1. Preventive Maintenance Schedule.

PM Action	Schedule
Cleaning outside of equipment	Every two months or when dust is seen on the surface of the equipment.
Cleaning inside of equipment	Every four months or when dust gets into the equipment.
Looking for damage or wear to parts of the equipment	When the inside of the equipment is cleaned or the unit is not operating properly.
Unit performance test	Every six months, individually, or as a part of an overall system test, or at other times if it is suspected the unit is not operating properly.
Unit performance tests	After equipment has been reparied.

4.5.1 EXTERIOR CLEANING

Remove loose dirt accumulated on the outside of the unit with a moist paper towel, cloth, or brush. The brush is good for removing dirt on and around the front panel controls. Dirt and grease which is not removed can

be cleaned off with a paper towel or cloth made moist with a detergent and water solution. Do not use an abrasive cleaner.

4.5.2 INTERIOR CLEANING

Dust on the inside of the unit should be removed as it may hold tiny conductive particles or it may cause electrical circuit parts to overheat. The best way to clean the inside is to blow it out gently with a nondestructive, low-pressure air stream. An alternative is to vacuum the dust off using a small brush to loosen the dirt.

4.6 GENERAL MAINTENANCE

Many failures can be detected by looking at the circuit boards and wiring. A complete inspection of the unit should be made during the cleaning operation for signs of mechanical and electrical failures. A change in the color of a part due to an overheated condition is usually an indication of a problem area in the equipment. Mechanical parts, including front panel control connectors, should be checked for wear, loose connections, bad alignment, or other possible causes of defective operation. Worn parts should be replaced and loose panel controls tightened. Check for loose cable connections, and tighten those connectors. Ensure that all circuit boards are held tightly in their receptacle.

After a repair has been made, alignment should be carried out, if necessary, and appropriate performance tests should be used to verify proper operation.

When removing components from a printed-circuit board for inspection or replacement, be especially careful not to damage the track. The soldering iron power should be no larger than 40 Watts, and a solder sipper or wicking procedure should be employed when removing solder. Noncorrosive soldering flux should be used when removing solder by wicking. In returning components to the board, make sure the holes are clear and be careful that the leads do not catch the edge of the track and lift it from the board. A good grade of rosin core 60/40 solder should be used. Heat no longer than is necessary to achieve a good joint. A heat sink should be used where possible.

When specified equipment is not available, its equivalent may be used provided the equipment meets or exceeds the specifications of the replaced equipment.

4.7 TUNER PERFORMANCE TESTS

4.7.1 GENERAL

This performance test procedure may be used for initial inspection, periodic checks, or to confirm performance specifications after repairs have been made. These tests should be carried out only by skilled technicians using the equipment listed in Table 4-2. If receiver problems exist while performing these tests, troubleshoot the appropriate module subassembly, or circuit.

When performing these tests, the technician should follow the guidelines below.

1. Read each paragraph carefully from beginning to end before attempting to perform the test described in the paragraph.

2. All tests are to be performed under the following environmental conditions unless otherwise specified:

   Temperature +25°C ±5°C (77°F ±9°F)

3. All test equipment shall be allowed a warm-up period of at least 30 minutes before the start of any test.

4. All inputs to and outputs from the equipment under test which are not in use during any particular test are to be terminated with their characteristic impedances.

5. All equipment covers must be in place except when a particular test requires their removal.

4.7.2 TEST EQUIPMENT REQUIRED

The test equipment listed in Table 4-2 or equivalents are required for performing tuner performance tests. All the equipment, however, is not used in any one test.

Table 4-2. Test Equipment Required.

	Name	Manufacturer	Model No.
1.	Synthesized Signal Generator (2)	Hewlett-Packard	8673C
2.	Power Meter	Hewlett-Packard	436A
3.	Frequency Counter	Hewlett-Packard	5340A
4.	Spectrum Analyzer	Hewlett-Packard	8566B
5.	Noise Figure Meter	Hewlett-Packard	8970A
6.	Noise Diode	Hewlett-Packard	346C
7.	Power Combiner	Watkins-Johnson	WJ-8969
8.	IFC Unit	Company	IFC

4.7.3 NOISE FIGURE, RF/IF GAIN

a. Connect equipment as shown in Figure 4-1.

b. Calibrate noise figure meter as follows:

   Enter: 1.3
   Press: SPECIAL FUNCTION

Press: START FREQ
Enter: Lower Frequency of Tuner
Press: STOP FREQ
Enter: Upper Frequency of Tuner
Enter: 3.0
Press: SPECIAL FUNCTION
Enter: 160 MHz
Press: SMOOTHING (DECREASE or INCREASE button to obtain "smoothing"=8)
Press: CORRECTED NOISE FIGURE AND GAIN

Connect noise diode to the noise figure meter input.

Press: CALIBRATE

The noise figure meter should now be calibrated.

c. Connect noise diode to the RF input of the tuner and tune tuner to the low band edge. Set noise figure meter to the same frequency as the tuner.

d. Read and record the noise figure and RF/IF Gain on Table 4-3.

e. Repeat steps c and d for the remaining frequencies indicated on Table 4-3.

4.7.4 TUNING ACCURACY

a. Connect equipment as shown in Figure 4-2.

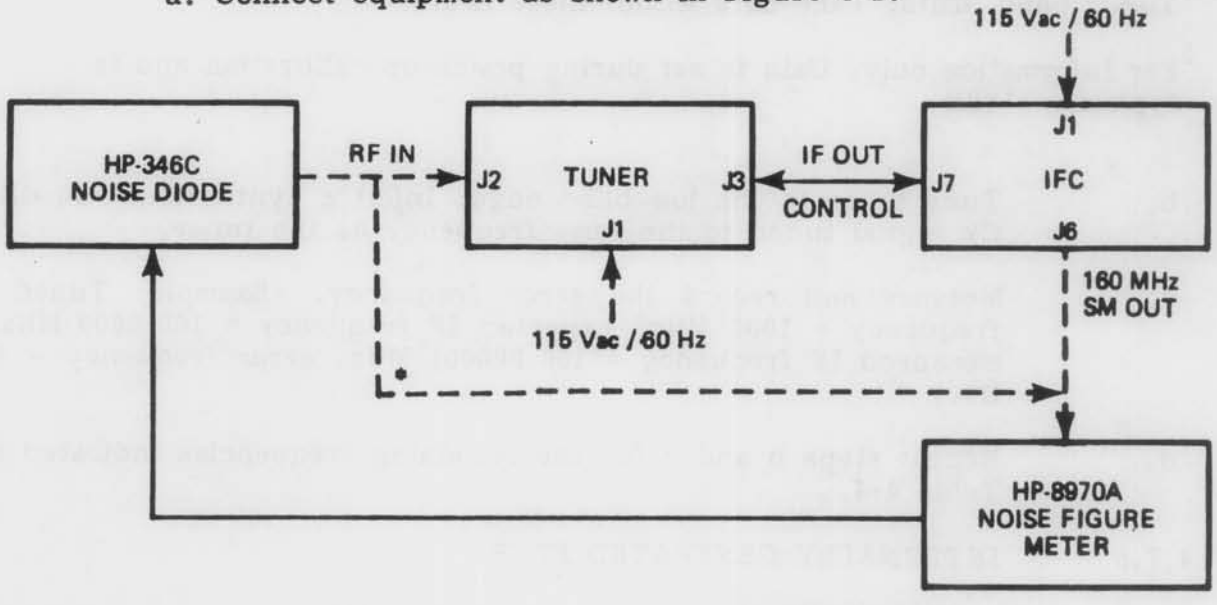


Figure 4-1. Noise Figure, RF/IF Gain Test Setup.

Table 4-3. Noise Figure and RF/IF Gain Specifications.

Tuner[1]	Tuned Frequency (MHz)	Noise Figure (dB)	Spec Max (dB)	RF/IF[2] Gain (dB)
TU0145, TU0112	1000	_____	15	_____
	1500	_____	15	_____
	2000	_____	15	_____
	2500	_____	15	_____
	2999	_____	15	_____
	3000	_____	15	_____
	3500	_____	15	_____
TU0412	4000	_____	15	_____
TU0145	4500	_____	15	_____
	5000	_____	15	_____
	5999	_____	15	_____
	6000	_____	15	_____
	7000	_____	15	_____
	8000	_____	15	_____
	8999	_____	15	_____
	9000	_____	15	_____
	10000	_____	15	_____
	11000	_____	15	_____
	12000	_____	15	_____
TU0412, TU0112	12400	_____	15	_____

[1]Tuner band limits. Take data within these limits.

[2]For information only. Gain is set during power-up calibration and is typically +18dB.

b. Tune tuner to the low band edge. Input a synthesized -30 dBm CW signal tuned to the same frequency as the tuner.

c. Measure and record the error frequency. (Example: Tuned frequency = 1000 MHz, expected IF frequency = 160.0000 MHz, measured IF frequency = 160.000001 MHz, error frequency = +1 Hz.)

d. Repeat steps b and c for the remaining frequencies indicated on Table 4-4.

4.7.5 INTERNALLY GENERATED SPURS

a. Connect equipment as shown in Figure 4-3.

b. Terminate the RF input of the tuner with 50 ohms termination.

c. Set spectrum analyzer to 160 MHz center frequency, 1 MHz resolution bandwidth, 10 kHz video bandwidth, 10 dB log per division, and a frequency span of 5 MHz per division.

d. Tune the tuner slowly across its entire band using a tuning rate of 100 kHz. Verify any spurs which occur above the tuner noise floor. Record on Table 4-5 the spur type, the tuned frequency at which the spur occurs, the spur frequency, the spur level, and the tuner noise level.

NOTE

To ensure the noise floor of the spectrum analyzer is lower than the tuner noise floor, disconnect the input to the spectrum analyzer and note that the noise floor displayed decreases.

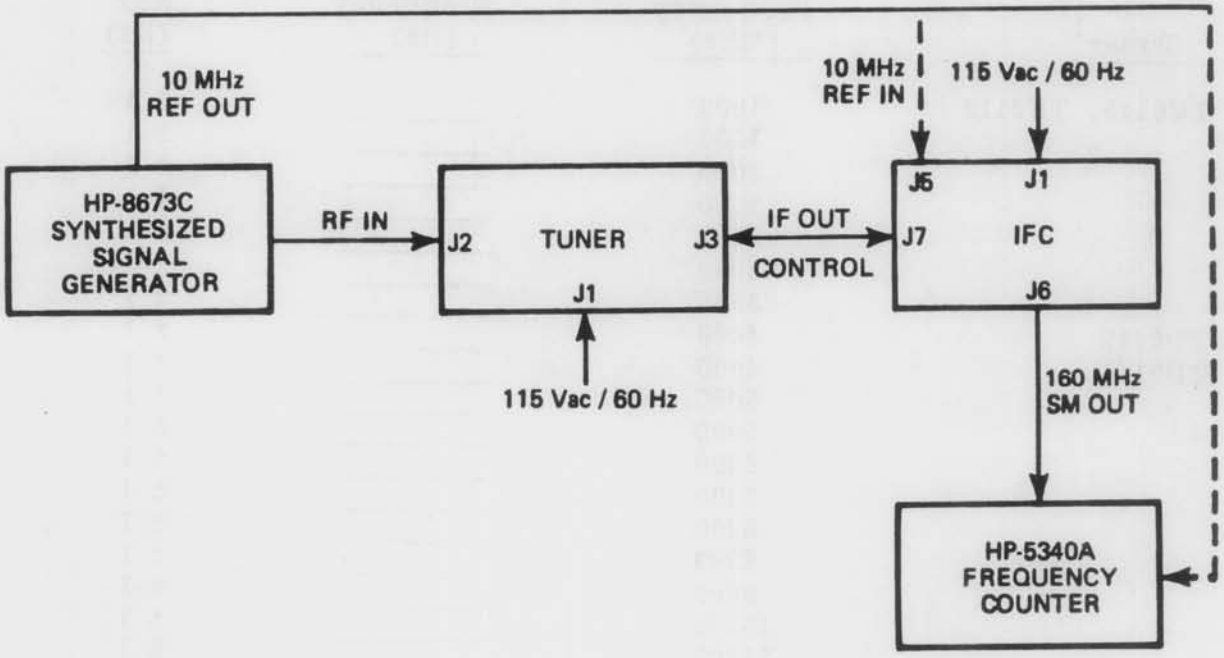


Figure 4-2. Tuning Accuracy (with external reference) Test Setup.

4.7.6 SINGLE SIGNAL SPURIOUS FREE DYNAMIC RANGE

a. Connect equipment as shown in Figure 4-3.

b. Input a synthesized -30 dBm CW signal tuned to the first frequency shown on table 4-6. Tune the tuner to the same frequency as the input frequency.

c. Set spectrum analyzer to 160 MHz center frequency, 1 MHz resolution bandwidth, 10 kHz video bandwidth, 10 dB log per division, and a frequency span of 5 MHz division.

NOTE

To ensure the noise floor of the spectrum analyzer is lower than the tuner noise floor, disconnect the input to the spectrum analyzer and note that the noise floor displayed decreases.

Table 4-4. Tuning Accuracy (with external reference) Specifications.

Tuner[1]	Tuned Frequency (MHz)	Error Frequency (Hz)	Spec Max (Hz)
TU0145, TU0112	1000	_____	± 1
	1500	_____	± 1
	2000	_____	± 1
	2500	_____	± 1
	2999	_____	± 1
	3000	_____	± 1
	3500	_____	± 1
TU0412	4000	_____	± 1
TU0145	4500	_____	± 1
	5000	_____	± 1
	5999	_____	± 1
	6000	_____	± 1
	7000	_____	± 1
	8000	_____	± 1
	8999	_____	± 1
	9000	_____	± 1
	10000	_____	± 1
	11000	_____	± 1
	12000	_____	± 1
TU0412, TU0112	12400	_____	± 1

[1]Tuner band limits. Take data within these limits.

d. Adjust the input signal power until the 160 MHz out signal, as observed on the spectrum analyzer, is at least 60 to 65 dB above the tuner noise level.

e. Tune tuner slowly across its entire band, using a tuning rate of 100 kHz.

f. IF a spurious signal is observed, vary input signal frequency and the tuner tuned frequency until the spur is at maximum power level.

g. For each spurious signal observed above the noise level, determine the type of spurious by varying input frequency and power. For example, a 2R* 4 spurious signal will exhibit a 2 unit change in either frequency or power for a corresponding 1 unit change in RF input signal. Likewise a 2L spurious signal will exhibit a 2 unit change in frequency for corresponding 1 unit change in LO frequency. Record the type, the tuned frequency, and frequency of the spur on Table 4-6.

h. Reduce input power until spurious signal is at MDS level as observed on the spectrum analyzer. Record this input power level on Table 4-6.

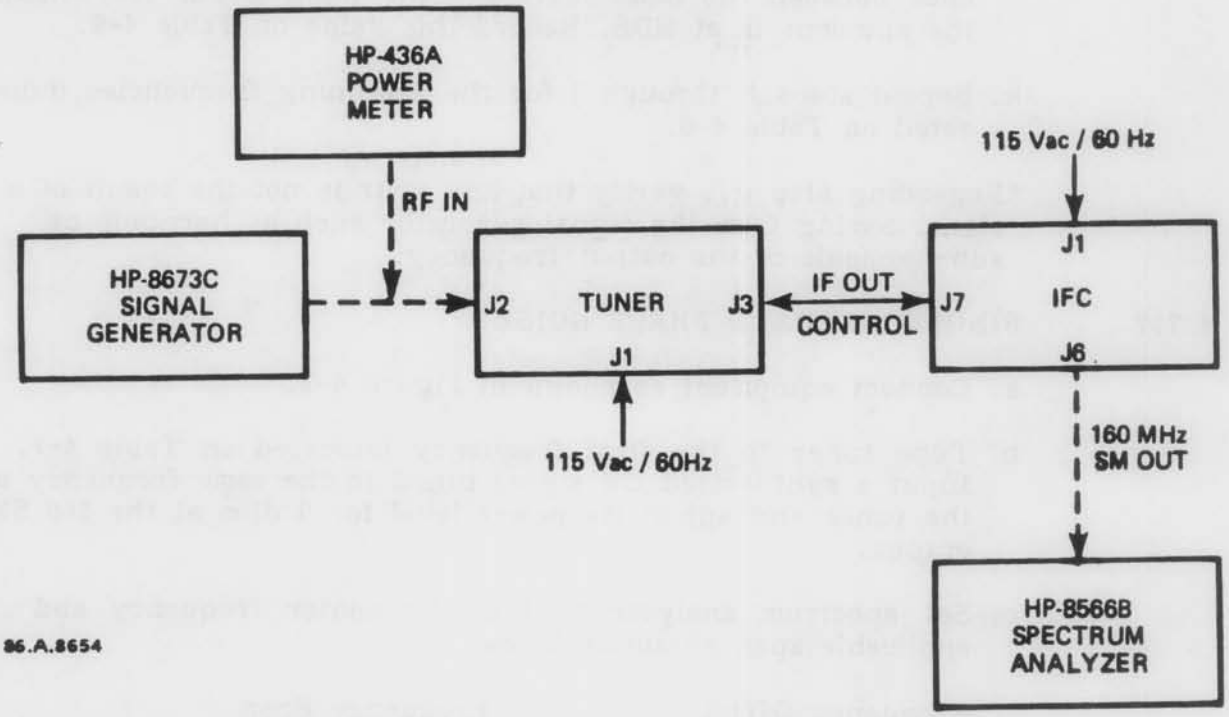


Figure 4-3. Internally Generated Spurs, Single Signal Spurious Free Dynamic Range, Single Side Band Phase Noise Image Rejection, IF Rejection, and RF/IF Bandwidth and Bandpass Ripple Test Setup.

Table 4-5. Internally Generated Spurs

Spur type	Tuned Freq. (MHz)	Spur Freq. (MHz)	Spur Level (dBm)	Tuner Noise Level (dBm)

i. Determine input noise level NL (referenced to 1 MHz BW) as NL = -114 dBm + NF, where NF is the measured noise figure at the tuned frequency. Measure NF per paragraph 4.7.3. Record noise figure and noise level on Table 4-6.

j. Determine spurious free dynamic range (SFDR) as the difference between the noise level and the input power for which the spurious is at MDS. Record this value on Table 4-6.

k. Repeat steps b through j for the remaining frequencies indicated on Table 4-6.

*Regarding step g., verify that any spur is not the result of a signal coming from the signal generator such as harmonic or sub-harmonic of the output frequency.

4.7.7 SINGLE SIDEBAND PHASE NOISE

a. Connect equipment as shown in Figure 4-3.

b. Tune tuner to the first frequency indicated on Table 4-7. Input a synthesized CW signal tuned to the same frequency as the tuner and adjust its power level for 0 dBm at the 160 SM output.

c. Set spectrum analyzer to 160 MHz center frequency and applicable span as shown below:

Frequency Offset	Frequency Span
100 Hz	250 Hz
1 kHz	2.5 kHz
10 kHz	25 kHz
100 kHz	250 kHz
1 MHz	2.5 MHz

Table 4-6. Single Spurious Free Dynamic Range Specifications.

Input Signal Freq. (MHz)	Spur Type	Tuned Freq. (MHz)	IF Freq. (MHz)	Input Power (dBm)	Noise[2] Figure (dBm)	Noise[3] Level (dBm)	[4] SFDR (dB)	Spec[4] Min (dB)
____	____	____	____	____	____	____	____	60
____	____	____	____	____	____	____	____	60
____	____	____	____	____	____	____	____	60
____	____	____	____	____	____	____	____	60
____	____	____	____	____	____	____	____	60
____	____	____	____	____	____	____	____	60

[1]Input Signal Frequencies TU0145 = 2204 MHz, 3925 MHz, 3935 MHz, 3973 MHz

TU0412 = 6100 MHz[6] 11000 MHz,

TU0112 = 2204 MHz 3925 MHz, 3935 MHz, 3973 MHz, 6100 MHz[6], 11000 MHz

[2]Noise Figure at the tuned frequency

[3]Noise Level (1 MHz BW) = -114 dBm + noise Figure

[4]SFDR = Input power - Noise Level

[5]Referenced to 1 MHz BW

[6]Specification is 50 dB (minimum)

d. To measure phase noise at 100 Hz offset press the following:

Step 1: PEAK SEARCH
Step 2: Δ
Step 3: 100
Step 4: Hz
Step 5: NORMAL
Step 6: SHIFT
Step 7: NORMAL

e. Video average the singal by pressing SHIFT, VIDEO BW.

f. Allow spectrum analyzer to sweep a minimum of 4 times.

g. Record phase noise on Table 4-7.

h. Turn off video averaging by pressing SHIFT, SWEEP TIME.

i. Repeat steps c through h for remaining offset frequencies by changing frequency span (step c) and offset frequency (steps 3 and 4 of step d).

j. Repeat steps b through h for remaining tuner frequencies indicated on Table 4-7.

4.7.8 1 dB COMPRESSION POINT

a. Connect equipment as shown in Figure 4-4.

b. Tune tuner to the low band edge. Input a synthesized -30 dBm CW signal tuned to the same frequency as the tuner.

c. Monitor the 160 MHz out with a power meter. (Note: An attenuator may be required in front of the power meter to prevent destruction of the power meter since the expected power output at compression may exceed +10 dBm.)

d. Increase input power by varying the signal generator attenuator until a decrease of 10 dB attenuation causes a 9 dB power increase. This is the 1 dB compression point.

e. Record, on Table 4-8, the input power for which the tuner is at 1 dB compression.

f. Repeat steps b through e for the remaining frequencies indicated on Table 4-8.

4.7.9 IMAGE REJECTION

a. Connect equipment as shown in Figure 4-3.

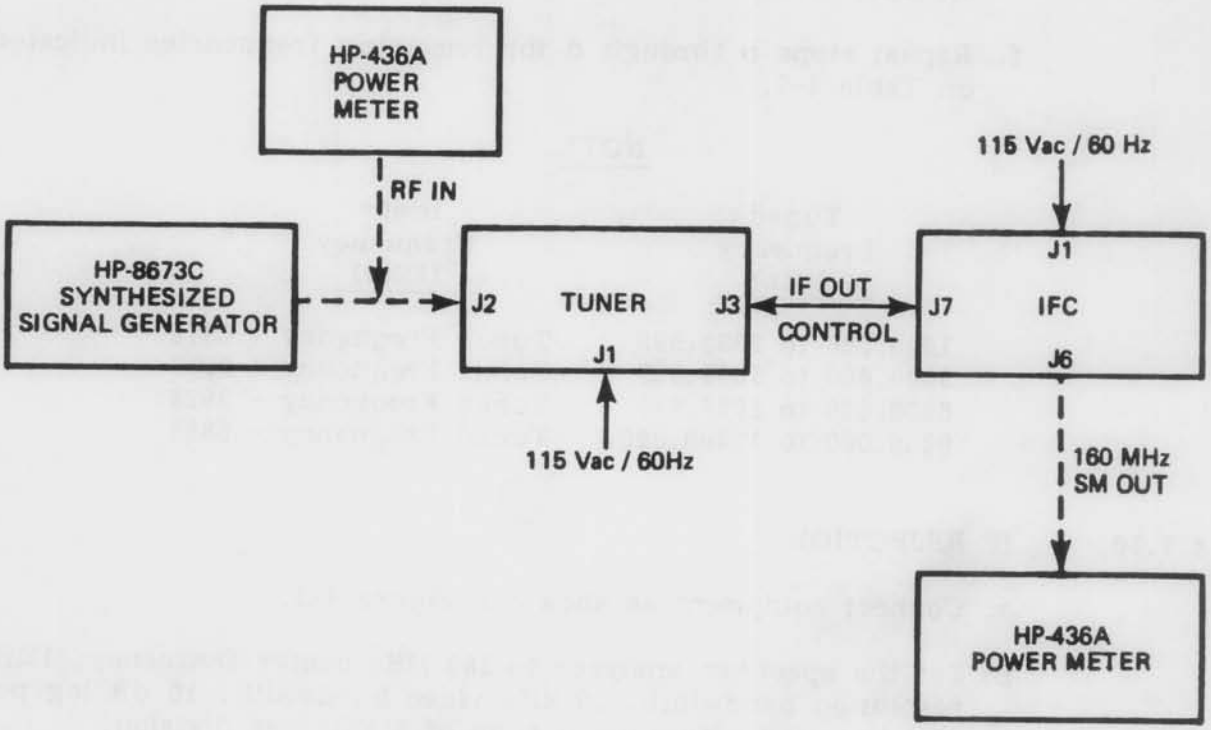
b. Set spectrum analyzer to 160 MHz center frequency, 1 MHz resolution bandwidth, 10 kHz video bandwidth, 10dB log per division, and a frequency span of 5 MHz per division.

c. Tune tuner to the low band edge. Input a synthesized CW signal tuned to the same frequency as the tuner and reduce its output to obtain an MDS level on the 160 MHz out as observed on the spectrum analyzer. Record this input power on Table 4-9.

Table 4-7. Single Sideband Phase Noise Specifications.

Tuner[1]	Tuned[1] Frequency (MHz)	L.O. Frequency MHz	Offset Frequency	Offset Level (dBc/Hz)	Spec Max (dBc/Hz)
			100 Hz	_____	--
TU0145	3000	4965	1 kHz	_____	-80
TU0412	6000	4036	10 kHz	_____	-83
TU0112	6000	4036	100 kHz	_____	-95
			1 MHz	_____	-118
TU0145	1600	6009	100 Hz	_____	--
TU0412	4000	5965	1 kHz	_____	-80
TU0112	1600	6009	10 kHz	_____	-83
			100 kHz	_____	-95
			1 MHz	_____	-118
TU0145	2999	7399	100 Hz	_____	--
TU0412	5999	7964	1 kHz	_____	-80
TU0112	5999	7964	10 kHz	_____	-83
			100 kHz	_____	-95
			1 MHz	_____	-118

[1]Identifies the tuner and the frequency the tuner is to be tuned to.



86.A.8655

Figure 4-4. 1 dB Compression Point Test Setup.

Table 4-8. 1 dB Compression Point Specifications.

Tuner	Tuned Frequency (MHz)	1 dB Compression Input Power (dBm)	Spec Min (dBm)
TU0145	1000	_____	-10
	3000	_____	-10
	4500	_____	-10
TU0412	4000	_____	-10
	8000	_____	-10
	12400	_____	-10
TU0112	1000	_____	-10
	4000	_____	-10
	7000	_____	-10
	12400	_____	-10

d. Tune signal generator to the image frequency indicated on the Table 4-9. Increase input power until the image level is at the MDS level obtained in step b. Record this input power on Table 4-9.

e. The difference between the input power levels obtained in steps b and c is the image rejection in dB. Record this value on Table 4-9.

f. Repeat steps b through d for remaining frequencies indicated on Table 4-9.

NOTE

Tuned Frequency (MHz)	Image Frequency (MHz)
1000.000 to 2999.999	Tuned Frequency + 8818
3000.000 to 5999.999	Tuned Frequency + 3930
6000.000 to 8999.999	Tuned Frequency - 3928
9000.000 to 12400.000	Tuned Frequency - 8816

4.7.10 IF REJECTION

a. Connect equipment as shown in Figure 4-3.

b. Set the spectrum analyzer to 160 MHz center frequency, 1MHz resolution bandwidth, 10 kHz video bandwidth, 10 dB log per
c. division, and a frequency span of 5 MHz per division.

Table 4-9. Image Rejection Specifications.

Tuner	Tuned Frequency (MHz)	Reference Level (dBm)	Image Frequency (MHz)	Image Level (dBm)	Image[1] Rejection (dB)	Spec Min (dB)
TU0145	1000	_____	9818	____	_____	70
	3000	_____	6930	____	_____	70
	4500	_____	8430	____	_____	70
TU0412	4000	_____	7930	____	_____	70
	8000	_____	4072	____	_____	70
	12400	_____	3584	____	_____	70
TU0112	1000	_____	9818	____	_____	70
	4000	_____	7930	____	_____	70
	7000	_____	3072	____	_____	70
	12400	_____	3584	____	_____	70

[1]Image Rejection = Image Level - Reference Level.

c. Tune tuner to the low band edge. Input a synthesized CW signal tuned to the same frequency as the tuner and reduce its output to obtain an MDS level on the 160 MHz out as observed on the spectrum analyzer. Record this input power on Table 4-9.

d. Tune signal generator to 160 MHz. Increase the signal generator output power 95 dB higher than the level obtained in step c.

e. Tune the tuner slowly across its entire band, using a 10 MHz tuning rate.

f. Verify that no signals occur 5dB above the MDS level noted in step c. Record on Table 4-10.

Table 4-10. IF Rejection Specifications

Tuner	IF Rejection across band (dB)	Spec Min (dB)
TU0145	_____	90
TU0412	_____	90
TU0112	_____	90

4.7.11 Two Tone 3rd ORDER INTERCEPT POINT

a. Connect equipment as shown in Figure 4-5.

b. Tune tuner to the first frequency indicated on Table 4-11. Tune 1st synthesized signal generator to 2 MHz below the tuned frequency of the tuner. Set its output power to -30 dBm CW as measured at the input of the tuner with the 2nd synthesized signal generator turned off. Turn 1st signal generator off.

c. Tune 2nd synthesized signal generator to 2 MHz above the tuner frequency. Set its output power to -30 dBm CW as measured at the input of the tuner. Turn 1st signal generator on.

d. The 160 MHz out as observed on the spectrum analyzer should appear as shown in Figure 4-6. If the two main signal peaks are not equal adjust them to the same height.

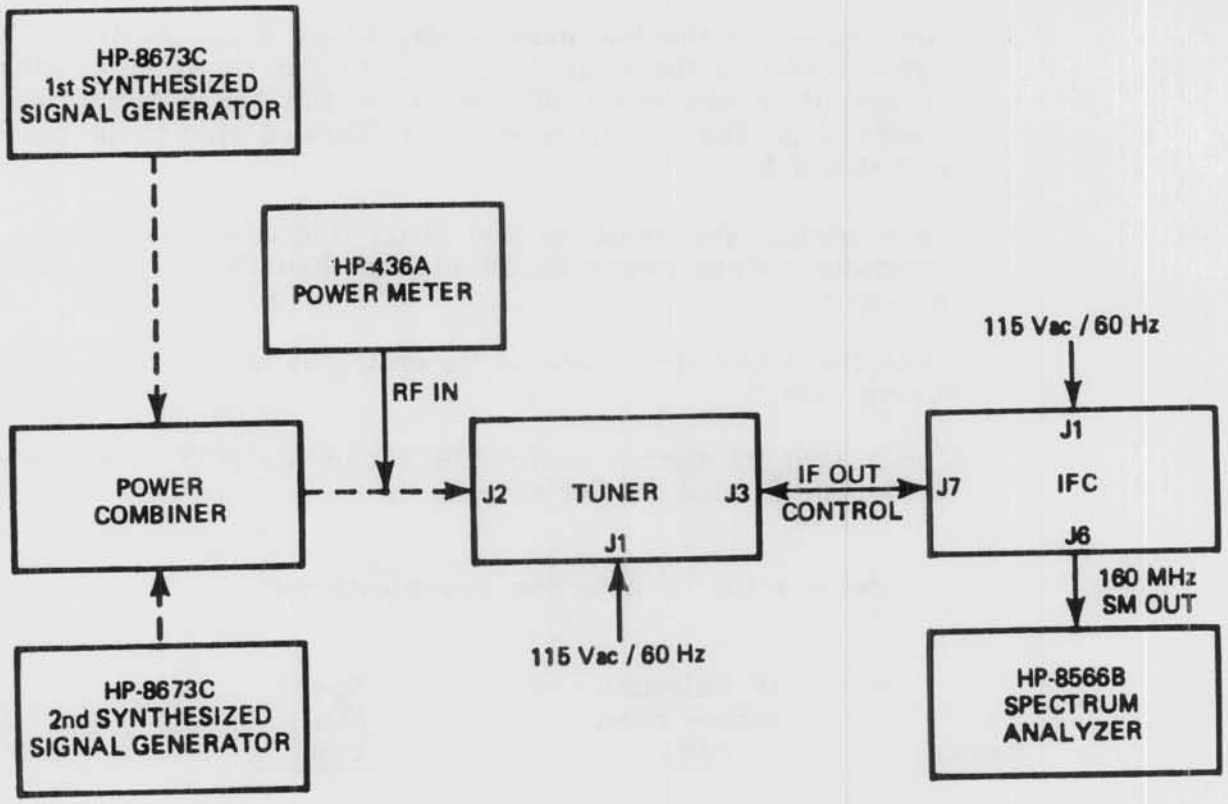


Figure 4-5. Third Order Intercept Point Test Setup.

e. Measure and record (on Table 4-11) the spurious suppression (R) in dB.

f. Calculate and record the two-tone 3rd order intercept point as: 3rd order intercept point = -30 dBm (input power level) + 1/2 R.

g. Repeat steps b through f for the remaining frequencies indicated on Table 4-11.

NOTE:

If 3rd order intermodulation products are not visible with -30 dBm input, increase input power until spurs are visible. Be sure to keep the input power below the tuner's 1 dB compression point.

4.7.12 L.O. RADIATION

a. Connect equipment as shown in Figure 4-7.

b. Tuner tuner to the first frequency indicated on Table 4-12. Tune center frequency of spectrum analyzer to the tuner L.O. frequency indicated on Table 4-12 and set its frequency span to 100 kHz and its noise floor level to -95 dBm.

c. Measure and record (on Table 4-12) the reradiated L.O. power coming out of the tuner RF in port.

d. Repeat steps b and c for the remaining frequencies indicated on Table 4-12.

NOTE

Tuned Frequency (MHz)	Image Frequency (MHz)
1000.000 to 2999.999	Tuned Frequency + 4409
3000.000 to 5999.999	Tuned Frequency + 1965
6000.000 to 8999.999	Tuned Frequency - 1964
9000.000 to 12400.000	Tuned Frequency - 4408

Table 4-11. Two Tone Third Order Intercept Point Specifications.

Tuner	Tuned Freq. (MHz)	Input Power (dBm)	Sig Gen #1 Frequency (MHz)	Sig Gen #2 Frequency (MHz)	Spurious Suppression (R) (dB)	Two Tone Third Order[1] Intercept Point (dBm)	Spec Min (dBm)
TU0145	1000	____	998	1002	_____	_____	-5
	3000	____	2998	3002	_____	_____	-5
	4500	____	4498	4502	_____	_____	-5
TU0412	4000	____	3998	4002	_____	_____	-5
	8000	____	7998	8002	_____	_____	-5
	12400	____	12398	12402	_____	_____	-5
							-5
TU0112	1000	____	998	1002	_____	_____	
	4000	____	3998	4002	_____	_____	-5
	7000	____	6998	7002	_____	_____	-5
	12400	____	12398	12402	_____	_____	-5

[1]Third Order Intercept Point = Input Power + 1/2 R.

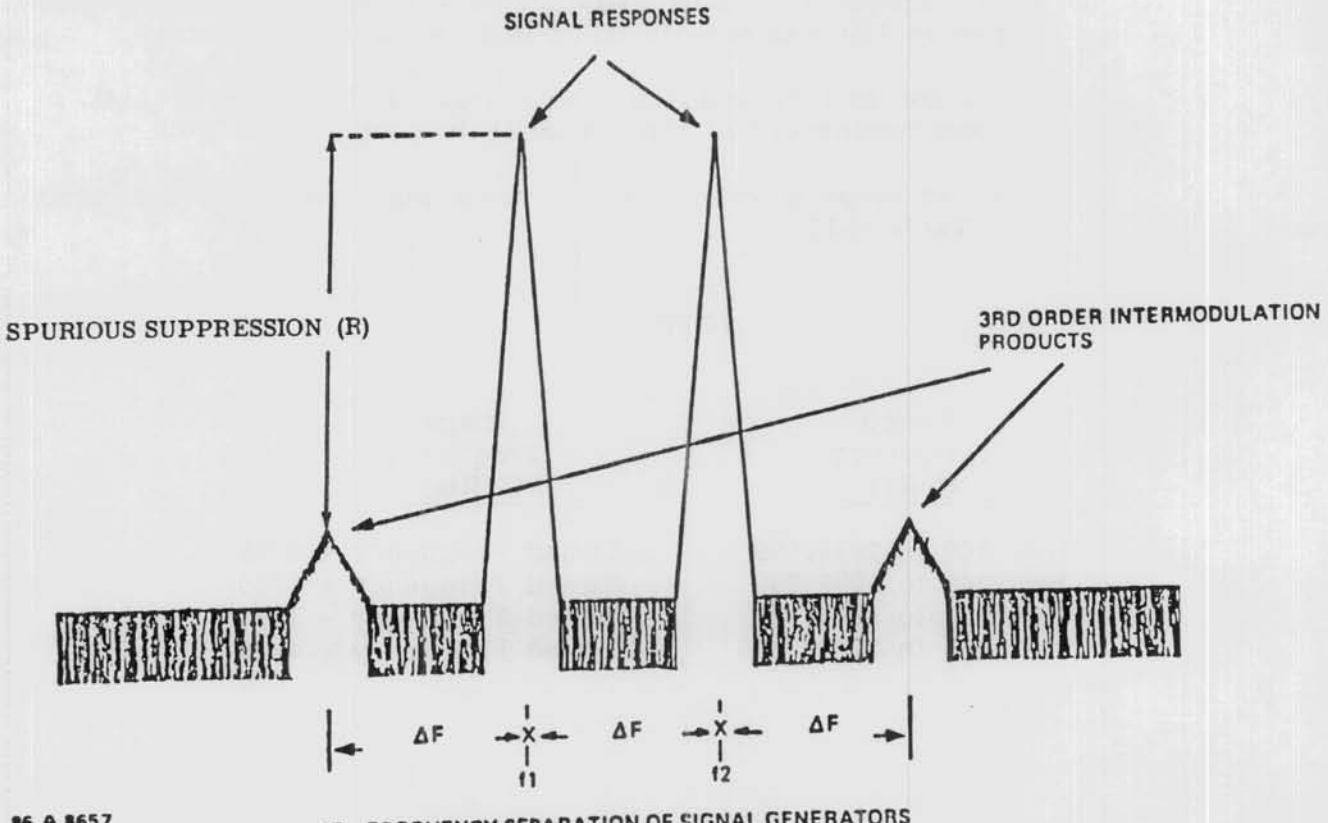


Figure 4-6. Two Tone Third Order Intermodulation Products.

4.7.13 RF/IF BANDWIDTH AND BANDPASS RIPPLE

Table 4-12. LO Radiation Specifications.

Tuner	Tuned Frequency (MHz)	LO Frequency (MHz)	LO Radiation (dBm)	Spec Max (dBm)
TU0145	3000	4965	_____	-80
	1600	6009	_____	-80
	2999	7399	_____	-80
TU0412	6000	4036	_____	-80
	4000	5965	_____	-80
	5999	7964	_____	-80
TU0112	6000	4036	_____	-80
	1600	6009	_____	-80
	5999	7964	_____	-80

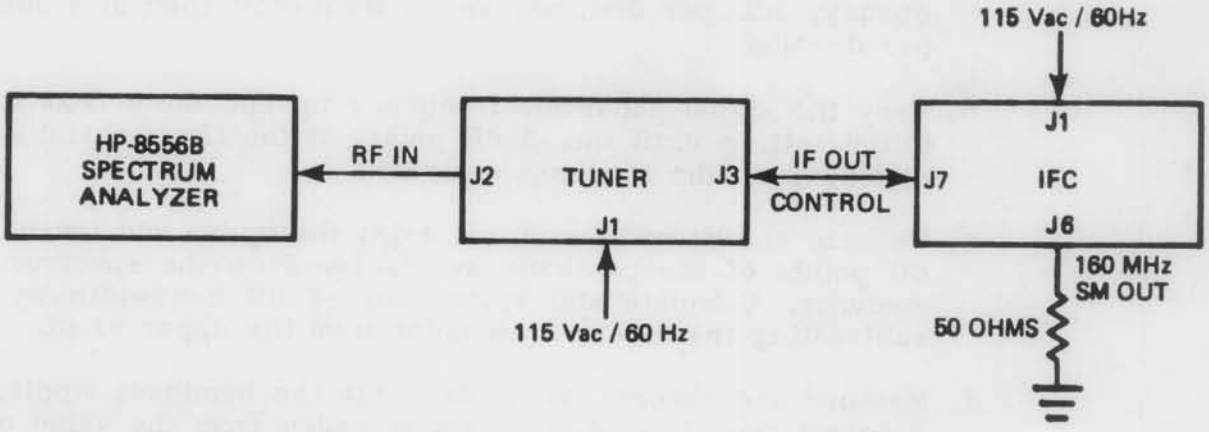


Figure 4-7. LO Radiation Test Setup.

Table 4-13. RF/IF Bandwidth and Bandpass Ripple Specifications.

Tuner	Tuned Freq. (MHz)	-3d Upper Freq. (MHz)	-3dB Lower Freq. (MHz)	-3dB Band-width (MHz)	Spec Min (MHz)	Band Pass Ripple (dB)	Spec Max (dB)
TU0145	1000	_____	_____	_____	40	_____	3
	3000	_____	_____	_____	40	_____	3
	4500	_____	_____	_____	40	_____	3
TU0142	4000	_____	_____	_____	50	_____	3
	8000	_____	_____	_____	50	_____	3
	12400	_____	_____	_____	50	_____	3
TU0112	1000	_____	_____	_____	40	_____	3
	3999	_____	_____	_____	40	_____	3
	4000	_____	_____	_____	50	_____	3
	7000	_____	_____	_____	50	_____	3
	12400	_____	_____	_____	40	_____	3

a. Connect equipment as shown in Figure 4-3.

b. Tune tuner to the low band edge. Input a synthesized -30 dBm CW signal tuned to the same frequency as the tuner.

c. Set spectrum analyzer to storage mode, 160 MHz center frequency, 1dB per division, and a frequency span of 6 MHz per division.

d. Vary the signal generator frequency up and down from its initial setting until the -3 dB points of the IF passband are displayed on the spectrum analyzer.

e. Measure and record (on Table 4-13) the upper and lower -3 dB points of the passband as displayed on the spectrum analyzer. Calculate and record the -3 dB bandwidth by subtracting the lower -3 dB point from the upper -3 dB

f. Measure and record (on Table 4-13) the bandpass ripple. Subtract the value of the deepest valley from the value of the highest peak found within the -3 dB points of the passband and record this value as ripple in dB.

g. Repeat steps b through f for the remaining frequencies indicated on Table 4-13.

4.7.14 AC POWER LINE CHECK

a. Set the ac switch on the tuner to 230 Vac. Connect tuner to 230 Vac 50 Hz single phase source.

b. Perform Tuning Accuracy test per paragraph 4.7.4 for the frequencies indicated on Table 4-14.

c. Return AC switch on the tuner to 115 Vac.

Table 4-14. AC Power Line Check (230 Vac 50 Hz) Specifications. (Tuning Accuracy with External Reference)

Tuner	Tuned Frequency (MHz)	Spec Max (Hz)
TU0145	1000	±1
	3000	±1
	4500	±1
TU0412	4000	±1
	8000	±1
	12400	±1
TU0112	1000	±1
	4000	±1
	7000	±1
	12400	±1

SECTION V

ASSEMBLIES AND PARTS LISTS

5.1 SCOPE OF SECTION

This section comprises an Illustrated Parts Breakdown (IPB) for the WJ-8969/TU-XXXX Tuner assemblies and modules. Table 5-1 is a list of manufacturers corresponding to the manufacturers' code numbers on the parts list.

5.2 USE OF IPB

The items in the lists, located in figures 5-1 through 5-38, are arranged by item number. The lists provide reference designations, abbreviated descriptions, manufacturers' codes, and part numbers. The meaning and use of Watkins-Johnson Company part numbers and the manufacturers' codes are described in the following paragraphs.

5.2.1 WATKINS-JOHNSON COMPANY PART NUMBERING SYSTEM

Parts designed or manufactured by Watkins-Johnson Company are identified by nine-digit part numbers. The first six digits of the part number represent the basic part design, and the last three digits, in the form of a dash number, represent the specific configuration of the basic part design.

5.2.2 MANUFACTURERS' CODES

Table 5-1 lists all of the manufacturers' codes used in the IPB. These five-digit numbers have been derived from Cataloging Handbook H4-2, Federal Supply Codes for Manufacturers, Code to Name. Codes are not used in the IPB for standard commercial or military parts.

5.3 PARTS ORDERING INFORMATION

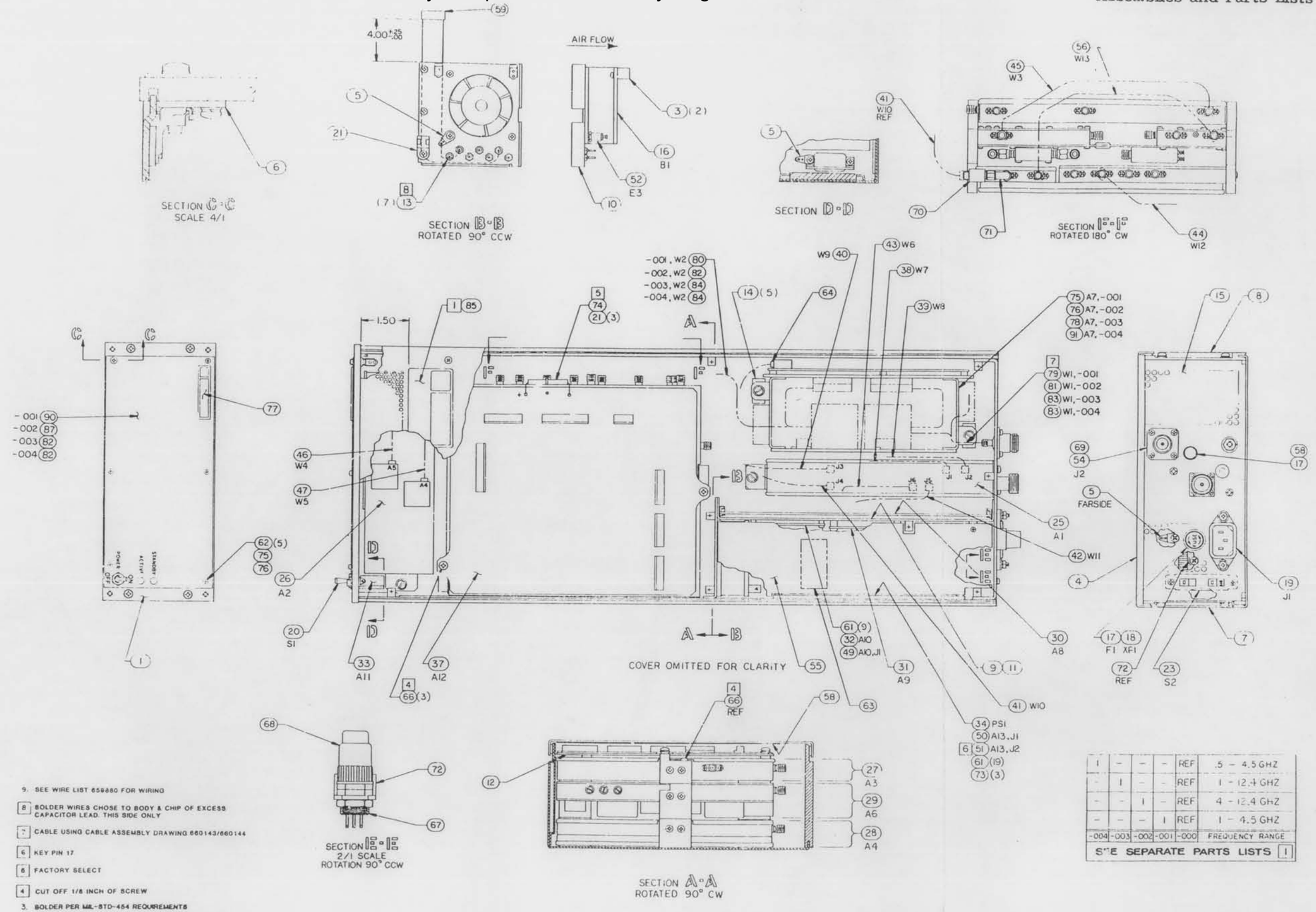
Replacement assemblies and modules may be obtained from Watkins-Johnson Company; however, replacements for standard commercial and military parts may be obtained more quickly and easily from local suppliers. When selecting a replacement part, be sure to determine the value, tolerance, rating, and description of the part from the applicable parts list.

When ordering replacement assemblies and modules from Watkins-Johnson Company, be sure to specify all pertinent information. Include information that identifies the specific system in which the module is used, as well as the name, part number, and serial number (if indicated) of

the next higher assembly for the module. Be sure to identify any modifications to the system that have been made since the system was shipped from the factory.

Replacement assemblies and modules may be ordered by mail, telephone, teletype, or cablegram. Send orders to the following address:

Mail:	Watkins-Johnson Company 2525 North First Street San Jose, California 95131-1097
Telephone:	(408) 262-1411
TWX:	910-338-0505
Cable:	WJ SNJ



9. SEE WIRE LIST 659880 FOR WIRING

[8] SOLDER WIRES CHOSE TO BODY & CHIP OF EXCESS CAPACITOR LEAD. THIS SIDE ONLY

[7] CABLE USING CABLE ASSEMBLY DRAWING 660143/660144

[6] KEY PIN 17

[5] FACTORY SELECT

[4] CUT OFF 1/8 INCH OF SCREW

3. SOLDER PER MIL-STD-454 REQUIREMENTS

2. REFERENCE DESIGNATIONS ARE FOR REFERENCE ONLY AND MAY OR MAY NOT APPEAR ON PART.

[1] SEE TABLE FOR APPLICABLE FREQUENCY RANGE AND SUPPLEMENTAL PARTS LIST DASH NO. ITEM NOS. SHOWN IDENTIFY COMMON PARTS PER "-000" PARTS LIST.

NOTES: UNLESS OTHERWISE SPECIFIED

1	-	-	-	REF	.5 - 4.5 GHZ
-	1	-	-	REF	1 - 12.4 GHZ
-	-	1	-	REF	4 - 12.4 GHz
-	-	-	1	REF	1 - 4.5 GHZ
-004	-003	-002	-001	-000	FREQUENCY RANGE

SEE SEPARATE PARTS LISTS [1]

659880

Figure 5-1. WJ-8969 Microwave Tuner Parts List, Part No. 659880 (Sheet 1 of 7)

ASSEMBLY NO: 659880-000 ASSY-TNR MICROWV WJ8969 REV. A

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
001	480673-1 659593-001	14482	PANEL FRONT	EA	1	
003	660437-001 660437-001	14482	NUT PLATE	EA	2	
004	659951-001 659951-001	14482	ASSY-COVER	EA	1	
005	MS77068-1 511030-201		LUG TERM SCR LKG NO4 MIL-C-15659	EA	3	
006	180575-1 659595-001	14482	SPCR PLATE	EA	1	
007	580492-1 659596-001	14482	ASSY-CHAS	EA	1	
008	480800-1 659601-001	14482	PLATE SIDE #1	EA	1	
009	380997-1 659603-001	14482	PARTITION	EA	1	
010	380999-1 659604-001	14482	PLATE MTG FAN	EA	1	
011	660116-001 660116-001	14482	INSUL MICROPROCESSOR CCA	EA	1	
012	660330-001 660330-001	14482	INSUL SIG 7 PWR DISTR BD	EA	1	
013	2425003W5U0102AA 056340-000	72982	CAP CER F/T 1KPF	EA	7	
014	281138-1 659607-001	14482	MTG BLOCK	EA	5	
015	380967-1 659608-001	14482	PANEL REAR	EA	1	
016	812 990018-603	23936	FAN	EA	1	B01
017	MDL-3/4 703141-075	71400	FUSE SLO-BLO DUAL 3/4AMP	EA	1	F01
018	340255 090888-000	75915	FUSEHOLDER PNL W/CAP AND	EA	1	XF01
019	3EF1 990018-604	05245	FLTR PWR LINE	EA	1	J01
020	7101PY1PZBE 070691-000	09353	SW TGL SPDT ANTI-ROTATION	EA	1	S01

Figure 5-1. WJ-8969 Microwave Tuner Parts List, Part No. 659880 (Sheet 2 of 7)

ASSEMBLY NO: 659880-000 ASSY-TNR MICROWV WJ8969 REV. A

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
021	TA1S8-M 500200-020	06383	CLAMP STRAP HOLDER	EA	3	
025	796527-1 659899-001	14482	ASSY-REF GEN/MUX	EA	1	A01
026	796528-1 659859-001	14482	ASSY-YIG	EA	1	A02
027	776014-1 659901-001	14482	ASSY-2ND LO SYNTHESIZER	EA	1	A03
028	776015-1 659903-001	14482	ASSY-1ST LO SYNTHESIZER	EA	1	A04
029	796559-1 659905-001	14482	ASSY-IF	EA	1	A06
030	659842-001 659842-001	14482	ASSY-CCA MICROPROCESSOR	EA	1	A08
031	796351-1 660053-001	14632	ASSY-CCA LINE FLTR	EA	1	A09
032	796529-1 659846-001	14482	ASSY-CCA VOLT REG	EA	1	A10
033	796554-1 659850-001	14482	ASSY-CCA LED	EA	1	A11
034	661099-001 661099-001	14482	PWR SPLY SWITCHING	EA	1	PS01
035	659883 659883	14482	OUTLINE DWG	EA	REF	
036	659882 659882	14482	SCHEM DIAG	EA	REF	
037	660187-001 660187-001	14482	ASSY-SIGNAL PWR DIST.	EA	1	A12
038	660144-001 660144-001	14482	ASSY-CABLE FLEX	EA	1	W07
039	660144-002 660144-002	14482	ASSY-CABLE FLEX	EA	1	W08
040	660144-003 660144-003	14482	ASSY-CABLE FLEX	EA	1	W09
041	660144-004 660144-004	14482	ASSY-CABLE FLEX	EA	1	W10
042	660144-005 660144-005	14482	ASSY-CABLE FLEX	EA	1	W11
043	660144-006 660144-006	14482	ASSY-CABLE FLEX	EA	1	W06

Figure 5-1. WJ-8969 Microwave Tuner Parts List, Part No. 659880 (Sheet 3 of 7)

ASSEMBLY NO: 659880-000 ASSY-TNR MICROWV WJ8969 REV. A

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
044	660144-007 / 660144-007	14482	ASSY-CABLE FLEX	EA	1	W12
045	660143-009 / 660143-009	14482	ASSY-CABLE	EA	1	W03
046	660143-010 / 660143-010	14482	ASSY-CABLE	EA	1	W04
047	660143-011 / 660143-011	14482	ASSY-CABLE	EA	1	W05
048	P-2392 / 990018-820	82389	AC LINE CORD	EA	1	
052	572-4838-01-0516 / 521164-312	71279	TERM INSUL STDF FEM 4-40	EA	1	E03
054	21011 / 090999-158	16179	ADPTR FLG MT N JK-OSM JK	EA	1	J02
055	660345-001 / 660345-001	14482	INSULATOR PWR SPLY	EA	1	
056	660144-010 / 660144-010	14482	ASSY-CABLE FLEX	EA	1	W13
058	633240-002 / 633240-002	14482	FUSEHOLDER SPARE	EA	1	
058	659701-001 / 659701-001	14482	INSUL COVER PWR DIST	EA	1	
059	660179-005 / 660179-005	14482	ASSY-CABLE	EA	1	
062	MS51957-1B / 563020-125		SCR PAN HD 2-56X1/8 BLACK FF-S-92	EA	5	
063	SDHV-1 / 599000-140		LABEL WARNING*HCL CO.MENL	EA	1	
064	660179-007 / 660179-007	14482	ASSY-CABLE	EA	1	
065	WL659880 / WL659880		WIRE LIST	EA	REF	
066	90301A020 / 554063-000	39428	SCR 6-32 RD HD 3"	EA	3	
067	GH7F-LSH / 070893-000	70192	CONN HEX MIN FEM	EA	1	
069	FSU-10/701 / 581790-010	04967	NUT RING-SHELL SIZE 10	EA	1	

Figure 5-1. WJ-8969 Microwave Tuner Parts List, Part No. 659880 (Sheet 4 of 7)

ASSEMBLY NO: 659880-000 ASSY-TNR MICROWV WJ8969 REV. A

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
070	632675-026 632675-026	14482	ATTEN PAD 6DB DC-18GHZ	EA	1	
071	CDI-5490 090893-000	30990	ADPTR 90 DEG ELBOW	EA	1	
073	661380-001 661380-001	14482	ASSY-HARNESS	EA	1	
075	NAS620C2B 580610-002		WASHER FLAT BLACK NO. 2	EA	5	
076	MS35338-134B 580630-002		WASHER LCK-SPR NO 2 FF-W-84	EA	5	
077	637697-001 637697-001	14482	NAMEPLATE SM	EA	1	
			EXPLOSION FINISHED			

ASSEMBLY NO: 659880-001 ASSY-TNR 1-4.5GHZ WJ8969 REV. A

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
070	659880-000 659880-000	14482	ASSY-TNR MICROWV WJ8969	EA	1	
075	660340-001 660340-001	14482	ASSY-1-4.5GHZ FRONT END	EA	1	A07
079	660143-002 660143-002	14482	ASSY-CABLE	EA	1	W01
080	660143-006 660143-006	14482	ASSY-CABLE	EA	1	W02
085	638910-002 638910-002	14482	LABEL	EA	1	
090	659594-001 659594-001	14482	PANEL BEZEL 1-4.5GHZ	EA	1	
			EXPLOSION FINISHED			

Figure 5-1. WJ-8969 Microwave Tuner Parts List, Part No. 659880 (Sheet 5 of 7)

ASSEMBLY NO: 659880-002 ASSY-TNR 4-12.4GHZ WJ8969 REV. A

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
070	659880-000 659880-000	14482	ASSY-TNR MICROWV WJ8969	EA	1	
076	660380-001 660380-001	14482	ASSY-4-12.4 GHZ FRONT END	EA	1	A07
081	660143-003 660143-003	14482	ASSY-CABLE	EA	1	W01
082	660143-007 660143-007	14482	ASSY-CABLE	EA	1	W02
085	638910-002 638910-002	14482	LABEL	EA	1	
087	659594-002 659594-002	14482	PANEL BEZEL 4-12.4GHZ	EA	1	

EXPLOSION FINISHED

ASSEMBLY NO: 659880-003 ASSY-TNR 1-12.4GHZ WJ8969 REV. A

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
070	659880-000 659880-000	14482	ASSY-TNR MICROWV WJ8969	EA	1	
078	660124-001 660124-001	14482	ASSY-DUAL YIG FRONT END	EA	1	A07
082	659594-003 659594-003	14482	PANEL BEZEL 1-12.4GHZ	EA	1	
083	660143-001 660143-001	14482	ASSY-CABLE	EA	1	W01
084	660143-005 660143-005	14482	ASSY-CABLE	EA	1	W02
085	638910-002 638910-002	14482	LABEL	EA	1	

EXPLOSION FINISHED

Figure 5-1. WJ-8969 Microwave Tuner Parts List, Part No. 659880 (Sheet 6 of 7)

ASSEMBLY NO: 659880-004 ASSY-TNR .5-4.5GHZ 8969 REV. A

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
070	659880-000 659880-000	14482	ASSY-TNR MICROWV WJ8969	EA	1	
082	659594-004 659594-004	14482	PANEL BEZEL .5-4.5GHZ	EA	1	
083	660143-001 660143-001	14482	ASSY-CABLE	EA	1	W01
084	660143-012 660143-012	14482	ASSY-CABLE	EA	1	W02
085	638910-002 638910-002	14482	LABEL	EA	1	
087	659905-002 659905-002	14482	ASSY-IF	EA	1	A06
091	660764-001 660764-001	14482	ASSY-.5-4.5GHZ FRONT END	EA	1	A07

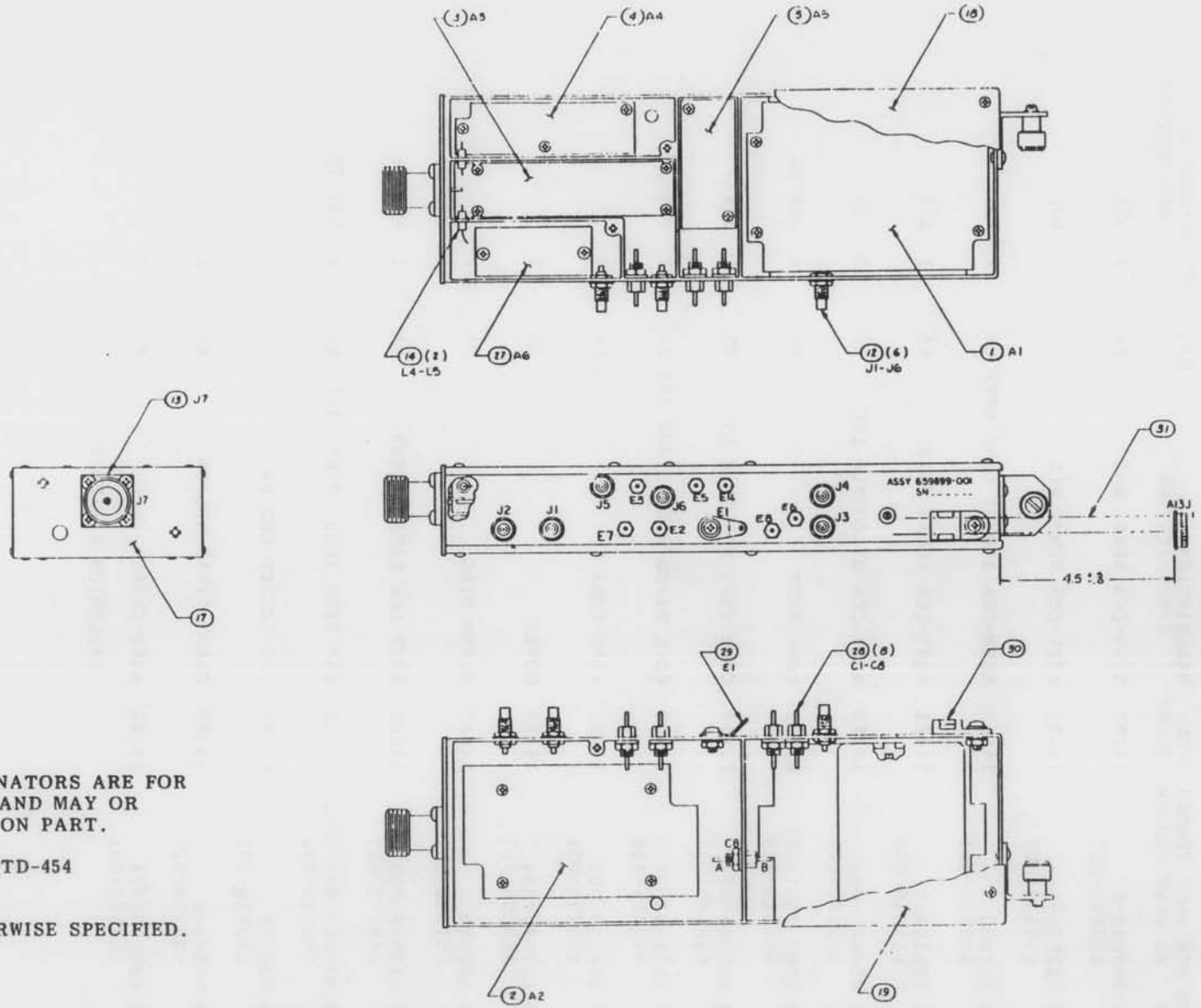
EXPLOSION FINISHED

NOTES: UNLESS OTHERWISE SPECIFIED

1:

VERSION	FREQ RANGE (GHZ)	SEE PAGE
-001	1-4.5	9
-002	4-12.4	10
-003	1-12.4	11
-004	.5-4.5	12

Figure 5-1. WJ-8969 Microwave Tuner Parts List, Part No. 659880 (Sheet 7 of 7)



3. REF WL 659859.

2. REFERENCE DESIGNATORS ARE FOR REFERENCE ONLY AND MAY OR MAY NOT APPEAR ON PART.

1. SOLDER PER MIL-STD-454 REQUIREMENTS.

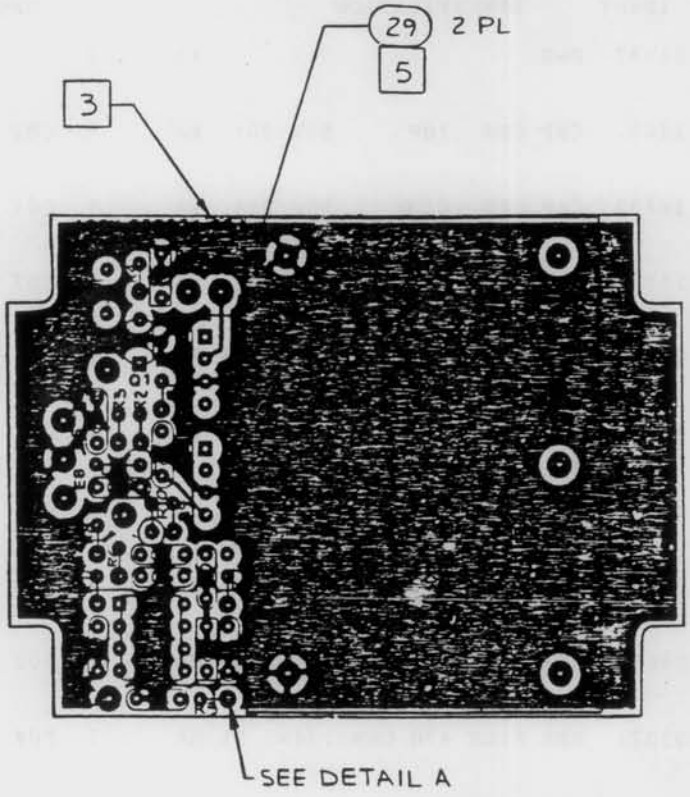
NOTES: UNLESS OTHERWISE SPECIFIED.

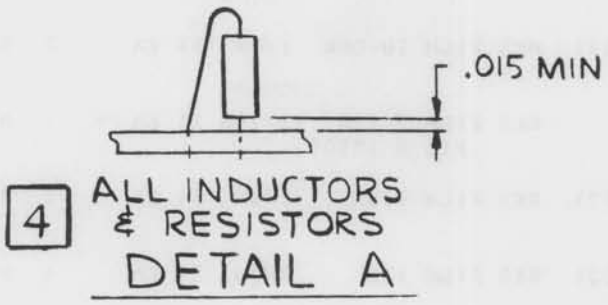
659899B

Figure 5-2. Reference Generator/Multiplexer A1 Parts List, Part No. 659899 (Sheet 1 of 2)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
001	281098-1 659891-001	14482	ASSY-CCA 50MHZ OSC	EA	1	A01
002	281099-1 659610-001	14482	ASSY-CCA 50MHZ PLL	EA	1	A02
003	281100-1 659614-001	14482	ASSY-CCA 160MHZ LINE DRVR	EA	1	A03
004	281101-1 659618-001	14482	ASSY-CCA 10MHZ FLTR	EA	1	A04
005	659622-001 659622-001	14482	ASSY-CCA G1 CONTLR LGC	EA	1	A05
012	1004-7511-000 990018-599	01121	CONN RCPT	EA	6	J01-06
013	660175-001 660175-001	14482	CONN TYPE N FLANGE MT	EA	1	J07
014	1025-32 760041-330	99800	COIL FIXED MOLD 3.3UH 10%	EA	2	L04 05
017	660139-001 660139-001	14482	ASSY-CHAS	EA	1	
018	660140-001 660140-001	14482	COVER	EA	2	
026	580518 659900	14482	SCHEM DIAG	EA	REF	
027	659778-001 659778-001	14482	ASSY-CCA DATA FILTER	EA	1	A06
028	54-785-005-503P 990018-690	33095	CAP FEED THRU .05UF 100V	EA	8	E01-08
029	1416-4 511010-201	83330	LUG SOLDER LKG #4	EA	1	
030	TA1S8-M 500200-020	06383	CLAMP STRAP HOLDER	EA	1	
031	660179-001 660179-001	14482	ASSY-CABLE	EA	1	
			EXPLOSION FINISHED			

Figure 5-2. Reference Generator/Multiplexer A1 Parts List, Part No. 659899 (Sheet 2 of 2)





5 BLUE BEAD ON COMPONENT INDICATES PIN 1.

4 STAND UP COMPONENTS PER DETAIL A.

3 MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH WHITE INK COLOR NO. 17875 PER FED-STD-595.

2 OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

NOTES: UNLESS OTHERWISE SPECIFIED.

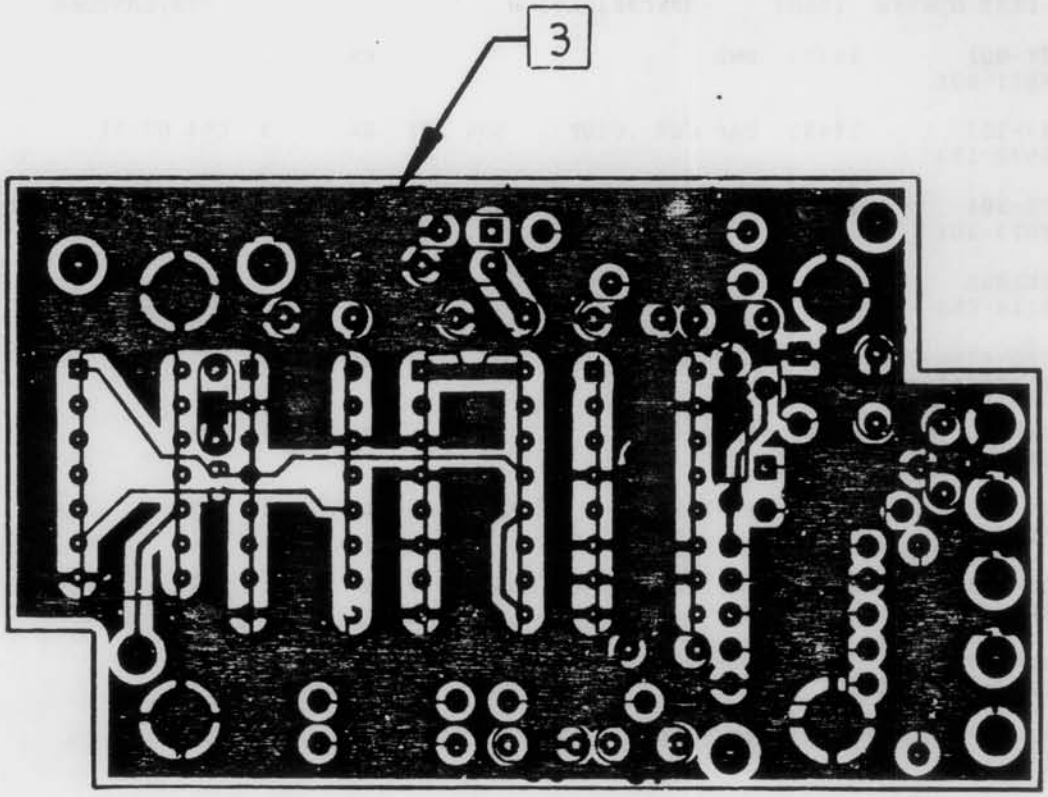
659891

Figure 5-3. 50 MHz Oscillator CCA A1A1 Parts List, Part No. 659891 (Sheet 1 of 2)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
						Rev. A
001	659892-001 659892-001	14482	PWB	EA	1	
003	660073-104 660073-104	14482	CAP CER .1UF 50V 20%	EA	6	C02 04 06 08 09 11
004	660073-103 660073-103	14482	CAP CER .01UF 50V 20%	EA	1	C01
005	660073-474 660073-474	14482	CAP CER .47UF 50V 20%	EA	2	C07 10
006	1537-76 760001-100	99800	COIL FIXED MOLD 100UH 10%	EA	2	L01 02
007	2N3904 780000-025	80131	XSTR	EA	1	Q01
008	CF1/4-10K/J 744074-100	09021	RES FILM 10K 1/4W 5%	EA	1	R05
009	CF1/4-33-OHMS/J 744071-330	09021	RES FILM 33-OHM 1/4W 5%	EA	1	R01
010	CF1/4-2.2K/J 744073-220	09021	RES FILM 2.2K 1/4W 5%	EA	2	R02 03
011	CF1/4-470-OHMS/J 744072-470	09021	RES FILM 470-OHM 1/4W 5%	EA	1	R04
012	CF1/4-68K/J 744074-680	09021	RES FILM 68K 1/4W 5%	EA	1	R06
013	CF1/4-10-OHMS/J 744071-100	09021	RES FILM 10-OHM 1/4W 5%	EA	2	R07 11
014	RN55C2211F 741553-221		RES FILM 2.21K 1/10W 1% MIL-R-10509	EA	1	R10
015	CF1/4-1.5K/J 744073-150	09021	RES FILM 1.5K 1/4W 5%	EA	1	R08
016	CF1/4-11K/J 744074-110	09021	RES FILM 11K 1/4W 5%	EA	1	R09
018	TSC-2-1 990018-624	15542	PWR SPLTR 1-400MHZ 2WAY	EA	2	U02 03
019	627601-232 627601-232	14482	IC-1007 CT PLSTC DIP	EA	1	U04
026	659857 659857	14482	SCHEM DIAG	EA	REF	
027	659970-001 659970-001	14482	XTAL OSC 50MHZ SCD	EA	1	U01
028	CK06BX105K 070716-000		CAP CER 1UF 50V 10% MIL-C-11015	EA	2	C03 05
029	660068-001 660068-001	14482	INSULATOR	EA	2	XU02 03

EXPLOSION FINISHED

Figure 5-3. 50 MHz Oscillator CCA A1A1 Parts List, Part No. 659891 (Sheet 2 of 2)



[3] MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH WHITE INK COLOR NO. 17875 PER FED-STD-595.

2 OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

NOTES: UNLESS OTHERWISE SPECIFIED.

659610A

Figure 5-4. 50 MHz Phase Lock Loop CCA A1A2 Parts List, Part No. 659610 (Sheet 1 of 3)

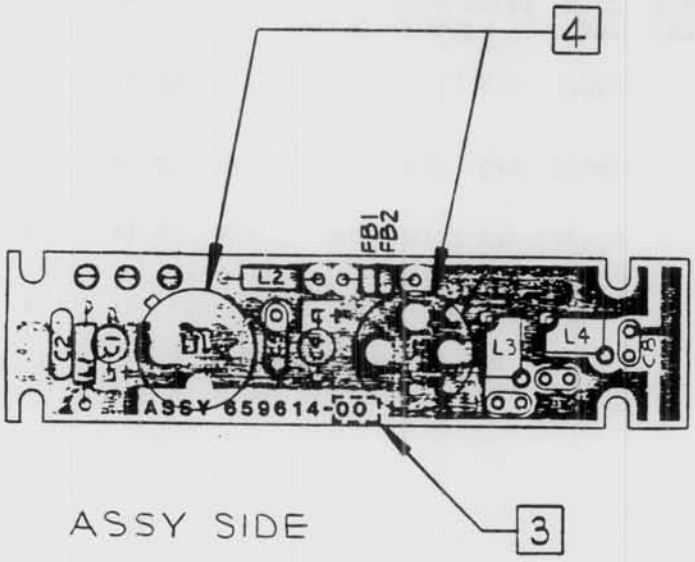
Rev. B

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
001	659611-001 659611-001	14482	PWB	EA	1	
002	660073-103 660073-103	14482	CAP CER .01UF 50V 20%	EA	3	C04 07 11
003	660073-104 660073-104	14482	CAP CER .1UF 50V 20%	EA	7	C02 03 05 06 08-10
004	CK06BX105K 070716-000		CAP CER 1UF 50V 10% MIL-C-11015	EA	1	C12
005	MMM-020-475R-20 990017-943	14674	CAP TANT 4.7UF 20V 20%	EA	1	C01
006	2N3904 780000-025	80131	XSTR	EA	1	Q01
007	627607-428 627607-428	14482	IC-74F160 CT PLSTC DIP	EA	1	U03
008	627607-683 627607-683	14482	IC-74LS390 CT PLSTC DIP	EA	1	U02
009	627605-493 627605-493	14482	IC-54LS04 MT CER DIP	EA	1	U01
010	627601-420 627601-420	14482	IC-14568 CT PLSTC DIP	EA	1	U04
013	659857 659857	14482	SCHEM DIAG	EA	REF	
015	CF1/4-470-OHMS/J 744072-470	09021	RES FILM 470-OHM 1/4W 5%	EA	1	R04
016	CF1/4-56-OHMS/J 744071-560	09021	RES FILM 56-OHM 1/4W 5%	EA	1	R06
017	CF1/4-220-OHMS/J 744072-220	09021	RES FILM 220-OHM 1/4W 5%	EA	1	R05
018	CF1/4-1K/J 744073-100	09021	RES FILM 1K 1/4W 5%	EA	1	R07
019	CF1/4-1.5K/J 744073-150	09021	RES FILM 1.5K 1/4W 5%	EA	1	R08
020	CF1/4-100-OHMS/J 744072-100	09021	RES FILM 100-OHM 1/4W 5%	EA	1	R01
022	1537-60 760012-470		COIL RF MOLDED 47UH	EA	2	L01 02
023	CF1/4-8.2K/J 744073-820	09021	RES FILM 8.2K 1/4W 5%	EA	1	R02
024	CF1/4-4.7K/J 744073-470	09021	RES FILM 4.7K 1/4W 5%	EA	1	R03

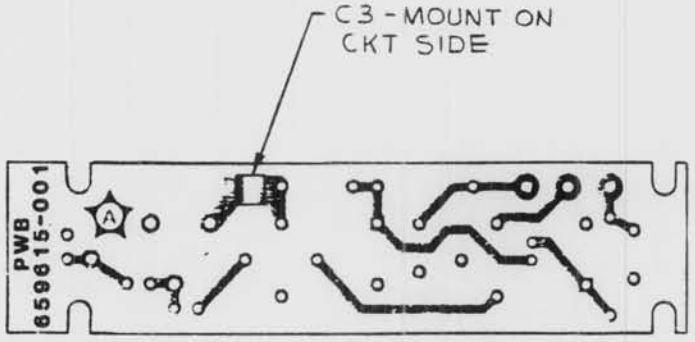
Figure 5-4. 50 MHz Phase Lock Loop CCA A1A2 Parts List, Part No. 659610 (Sheet 2 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
025	CF1/4-22K/J 744074-220	09021	RES FILM 22K 1/4W 5%	EA	1	R09
026	CF1/4-43K/J 990019-363	09021	RES FILM 43K 1/4W 5%	EA	1	R10
027	CF1/4-5.1K/J 990019-019	09021	RES FILM 5.1K 1/4W 5%	EA	1	R11
028	1N753 771000-007A		DIO ZR 6.2V .4W 10% DO7	EA	1	VR01
			EXPLOSION FINISHED			

Figure 5-4. 50 MHz Phase Lock Loop CCA A1A2 Parts List, Part No. 659610 (Sheet 3 of 3)



ASSY SIDE



CIRCUIT SIDE

4 SOLDER CASE OF U1 AND U2 TO GROUND PLANT.

3 MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH BLACK INK COLOR NO. 17038 PER FED-STD-595.

2 OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

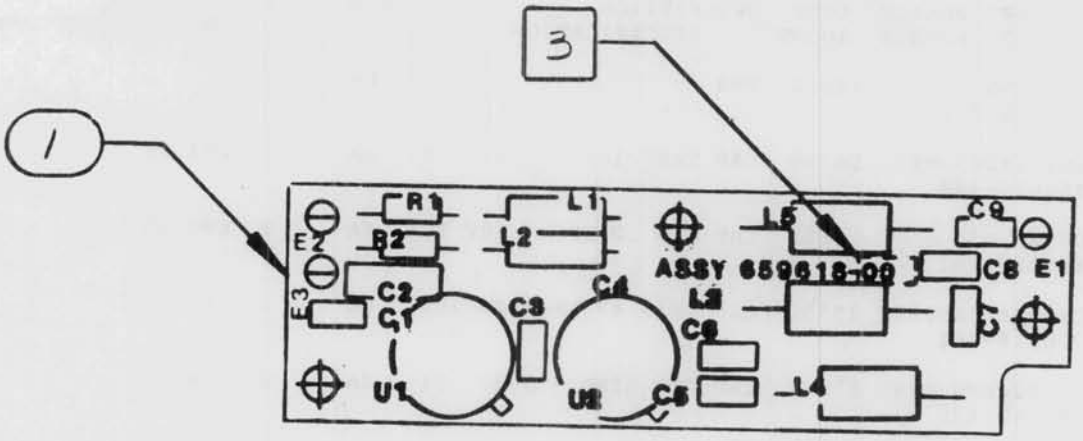
NOTES: UNLESS OTHERWISE SPECIFIED.

659614B

Figure 5-5. 160 MHz Line Driver CCA A1A3 Parts List, Part No. 659614 (Sheet 1 of 2)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
						Rev. B
001	659615-001 659615-001	14482	PWB	EA	1	
002	196D105X0035HE3 990018-464	56289	CAP TANT 1UF 35V 20%	EA	2	C01 04
003	660073-103 660073-103	14482	CAP CER .01UF 50V 20%	EA	2	C02 05
004	ATC100B471KP200X 990018-481	29990	CAP CHIP 470PF 200V 10%	EA	1	C03
005	150-100-NP0-620G 759161-620	51642	CAP CER 62PF 100V 2%	EA	2	C06 08
006	100-100-NP0-200G 759161-200	51642	CAP CER 20PF 100V 2%	EA	1	C07
007	56-590-65-4A 792020-014	02114	FERRITE BEAD	EA	2	FB01 02
008	1025-44 760042-100	99800	COIL FIXED MOLD 10UH 10%	EA	2	L01 02
009	660732-001 660732-001	14482	INDUCTOR 61MH	EA	2	L03 04
010	G1 990018-632	27956	ATTEN 5-2000MHZ TO-8	EA	1	U01
011	WJPA-2 990009-262	14482	AMPL CASC 10-300MHZ TO-8	EA	1	U02
013	659857 659857	14482	SCHEM DIAG	EA	REF	
			EXPLOSION FINISHED			

Figure 5-5. 160 MHz Line Driver CCA A1A3 Parts List, Part No. 659614 (Sheet 2 of 2)



[3] MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH BLACK INK COLOR NO. 17038 PER FED-STD-595.

2 OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

NOTES: UNLESS OTHERWISE SPECIFIED.

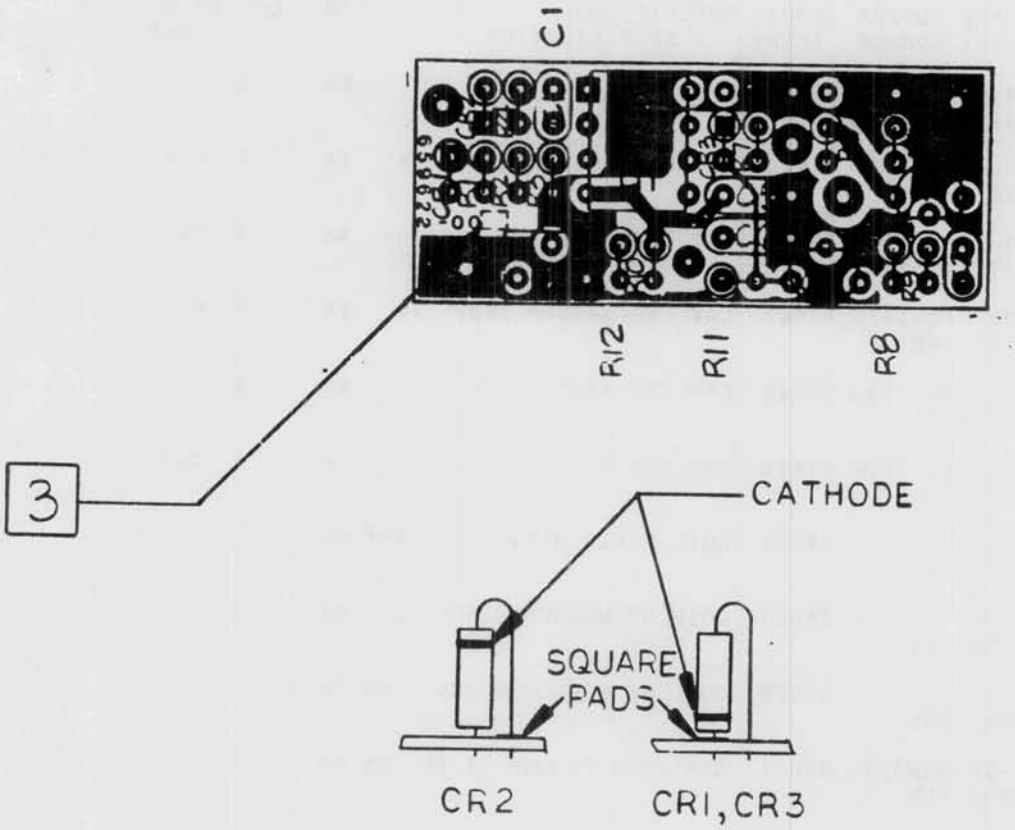
659618A

Figure 5-6. 10 MHz Filter CCA A1A4 Parts List, Part No. 659618 (Sheet 1 of 2)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
001	659619-001 659619-001	14482	PWB	EA	1	
002	150-100-NP0-102G 759163-100	51642	CAP CER 1000PF 100V 2%	EA	3	C01 03 05
003	660073-104 660073-104	14482	CAP CER .1UF 50V 20%	EA	2	C02 04
004	200-100-NP0-162G 759163-160	51642	CAP CER 1600PF 100V 2%	EA	2	C06 08
005	150-100-NP0-330G 759161-330	51642	CAP CER 33PF 100V 2%	EA	1	C07
006	200-100-NP0-750G 759161-750	51642	CAP CER 75PF 100V 2%	EA	1	C09
007	1025-48 760042-150	99800	COIL FIXED MOLD 15UH 10%	EA	2	L01 02
008	1537-00 760050-150	99800	COIL RF MOLDED .15UH 20%	EA	2	L03 05
009	1537-34 760051-820	99800	COIL RF MOLDED 8.2UH 10%	EA	1	L04
010	CF1/8-10-0HMS/J 744051-100	09021	RES FILM 10-OHM 1/8W 5%	EA	2	R01 02
011	627601-163 627601-163	14482	IC-120 MT MET CAN	EA	2	U01 02
013	659857 659857	14482	SCHEM DIAG	EA	REF	

EXPLOSION FINISHED

Figure 5-6. 10 MHz Filter CCA A1A4 Parts List, Part No. 659618 (Sheet 2 of 2)



[3] MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH BLACK INK COLOR NO. 17038 PER FED-STD-595.

2 OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

NOTES: UNLESS OTHERWISE SPECIFIED.

659622C

Figure 5-7. G1 Controller Logic CCA A1A5 Parts List, Part No. 659622 (Sheet 1 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS (Rev. C)	
001	659623-001 659623-001	14482	PWB	EA	1		
002	150-100-NP0-221G 759162-220	51642	CAP CER 220PF 100V 2%	EA	2	C01 02	
003	660073-104 660073-104	14482	CAP CER .1UF 50V 20%	EA	3	C03-05	
004	1N751A 771000-005B		DIO ZR 5.1V .4W 5% DO7	EA	1	CR01	
005	1N753A 771000-007B		DIO ZR 6.2V .4W 5% DO7	EA	1	CR02	
006	1N4449 775000-001	80131	DIO HI COND HS SW 75PPV	EA	1	CR03	
007	2N4403 780000-023	80131	XSTR PNP HI SPD TO-92	EA	1	Q01	
008	U1899E 780000-024	15818	XSTR JFET SW	EA	1	Q02	
009	RN55C2743F 741555-274		RES FILM 274K 1/10W 1% MIL-R-10509	EA	1	R01	
010	RN55C2742F 741554-274		RES FILM 27.4K 1/10W 1% MIL-R-10509	EA	1	R02	
011	RN55C8251F 741553-825		RES FILM 8.25K 1/10W 1% MIL-R-10509	EA	1	R03	SEE NOTE 1
012	CF1/4-10K/J 744074-100	09021	RES FILM 10K 1/4W 5%	EA	1	R04	
013	CF1/4-1K/J 744073-100	09021	RES FILM 1K 1/4W 5%	EA	1	R05	
014	CF1/4-4.7K/J 744073-470	09021	RES FILM 4.7K 1/4W 5%	EA	1	R06	
015	CF1/4-10-OHMS/J 744071-100	09021	RES FILM 10-OHM 1/4W 5%	EA	2	R07 10	
016	RN55C2000F 741552-200		RES FILM 200-OHM 1/10W 1% MIL-R-10509	EA	2	R08 09	
017	CF1/8-220K/J 744055-220	09021	RES FILM 220K 1/8W 5%	EA	1	R11	SEE NOTE 1
018	RN55C9090F 741552-909		RES FILM 909-OHM 1/10W 1% MIL-R-10509	EA	1	R12	
019	RT26C2W202 090737-000		RES VAR WW SCR ADJ 2K MIL-R-27208	EA	1	R13	

Figure 5-7. G1 Controller Logic CCA A1A5 Parts List, Part No. 659622 (Sheet 2 of 3)

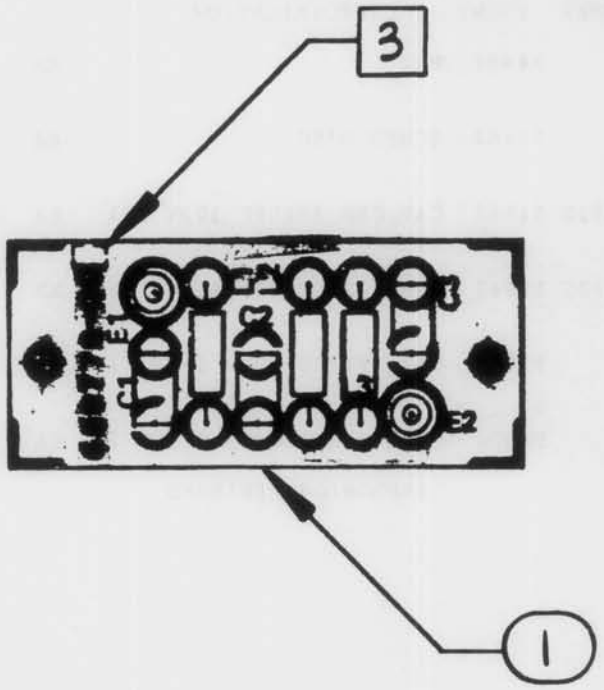
ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
020	627603-326 627603-326	14482	IC-34002 CT PLSTC DIP	EA	1	U01
021	CK05BX222K 750153-220		CAP CER 2200PF 100V 10% MIL-C-11015	EA	1	C06
026	659857 659857	14482	SCHEM DIAG	EA	REF	

EXPLOSION FINISHED

NOTES: UNLESS OTHERWISE SPECIFIED

[1] FACTORY SELECT NOMINAL VALUE SHOWN

Figure 5-7. G1 Controller Logic CCA A1A5 Parts List, Part No. 659622 (Sheet 3 of 3)



[3] MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH WHITE INK COLOR NO. 17875 PER FED-STD-595.

2 OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

NOTES: UNLESS OTHERWISE SPECIFIED.

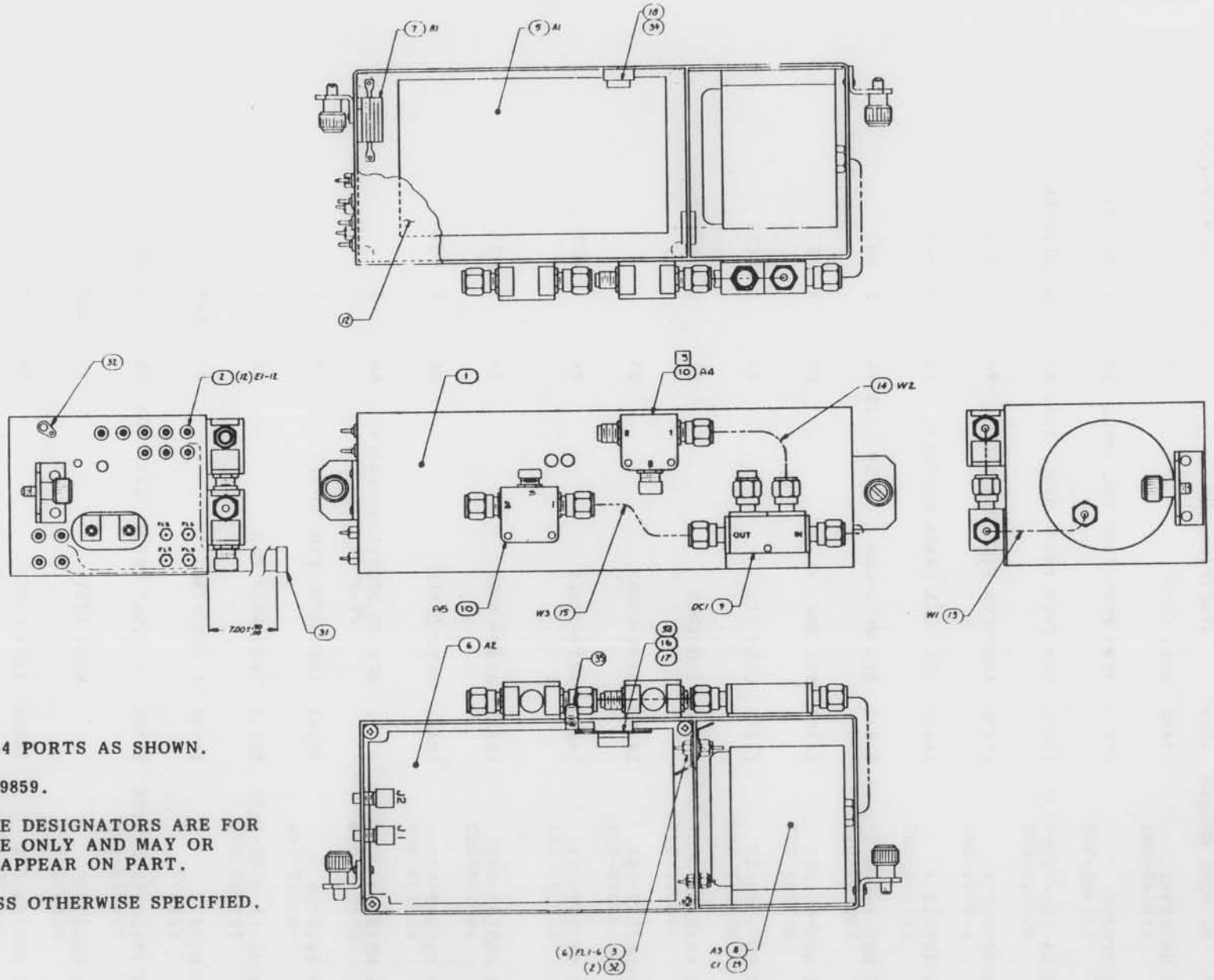
659778

Figure 5-8. 1 MHz Serial Data Filter CCA A1A6 Parts List, Part No. 659778 (Sheet 1 of 2)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
001	659779-001 659779-001	14482	PWB	EA	1	
002	659857 659857	14482	SCHEM DIAG	EA	REF	
004	300-100-NP0-392G 759163-390	51642	CAP CER 3900PF 100V 2%	EA	2	C01 03
005	300-100-NP0-622G 759163-620	51642	CAP CER 6200PF 100V 2%	EA	1	C02
007	1025-48 760042-150	99800	COIL FIXED MOLD 15UH 10%	EA	2	L01 02
008	1025-32 760041-330	99800	COIL FIXED MOLD 3.3UH 10%	EA	1	L03

EXPLOSION FINISHED

Figure 5-8. 1 MHz Serial Data Filter CCA A1A6 Parts List, Part No. 659778 (Sheet 2 of 2)



[3] REMARK A4 PORTS AS SHOWN.

2. REF WL 659859.

1. REFERENCE DESIGNATORS ARE FOR REFERENCE ONLY AND MAY OR MAY NOT APPEAR ON PART.

NOTES: UNLESS OTHERWISE SPECIFIED.

659859B

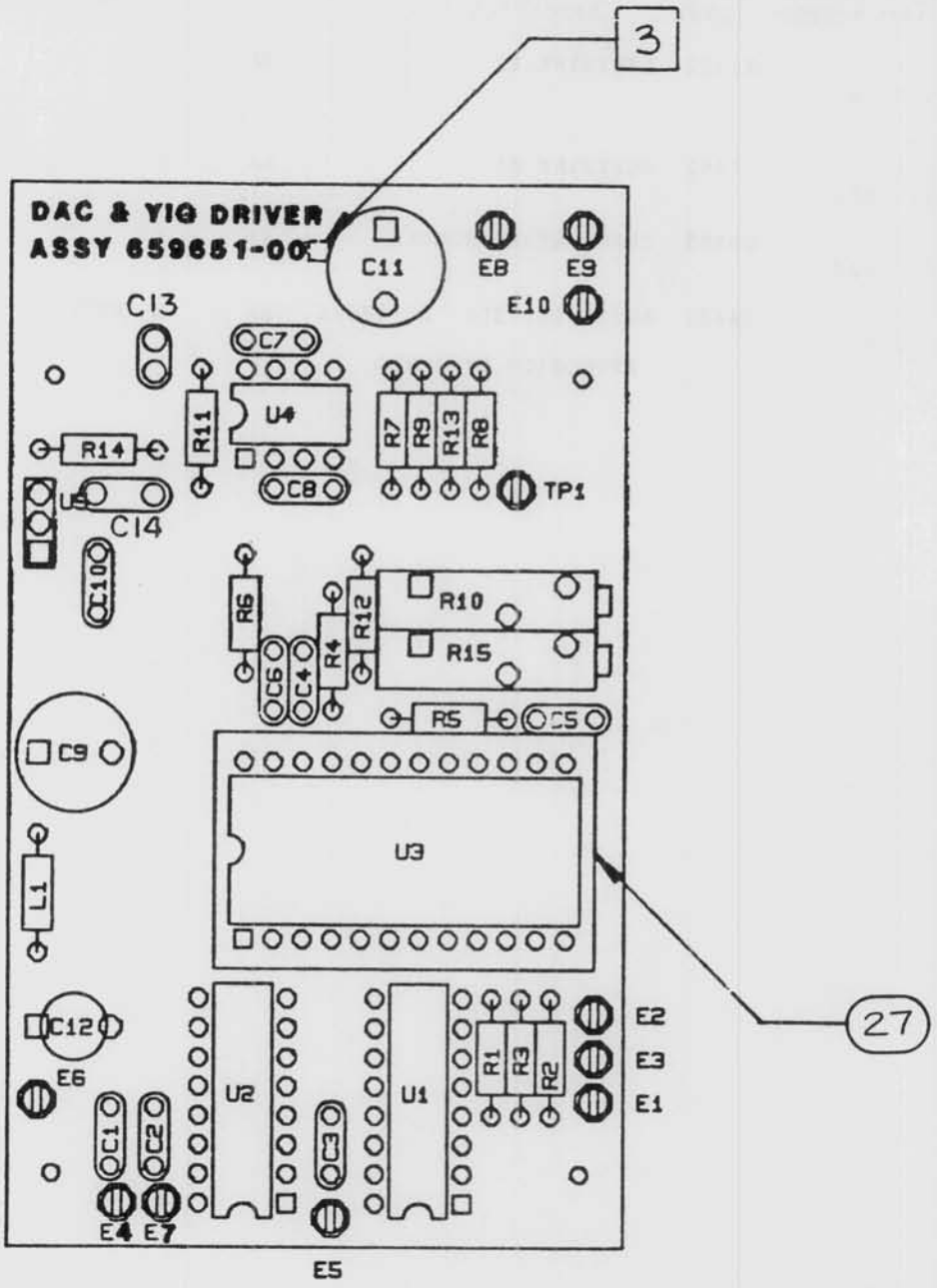
Figure 5-9. YIG Assembly A2 Parts List, Part No. 659859 (Sheet 1 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS (Rev. B)
001	580463-1 659640-001	14482	ASSY-CHAS	EA	1	
002	SFU16Y 529060-003	04013	TERM FEED THRU TFL INSUL	EA	12	E01-12
003	54-785-005-503P 990018-690	33095	CAP FEED THRU .05UF 100V	EA	6	FL01-06
005	380918-1 659651-001	14482	ASSY-CCA YIG DRVR & DAC	EA	1	A01
006	380919-1 659655-001	14482	ASSY-CCA PHASE DET/FLTR	EA	1	A02
007	RH5-1-OHM-1 090999-015	91637	RES WW 1-OHM 5W 1%	EA	1	R01
008	659900-001 659900-001	14482	YIG OSC	EA	1	A03
009	CL-4080-10 990018-616	18203	CPLR DIR	EA	1	DC01
010	60A6001 990018-617	12855	ISOLATOR	EA	2	A04 05
012	660070-001 660070-001	14482	ASSY-COVER	EA	1	
013	660109-001 660109-001	14482	ASSY-CABLE	EA	1	W01
014	660109-002 660109-002	14482	ASSY-CABLE	EA	1	W02
015	660109-003 660109-003	14482	ASSY-CABLE	EA	1	W03
016	MS18211-3 574041-000		SCR FL HD NYL 4-40X1/4 FF-S-92	EA	1	
017	1009-58 702028-003	30161	INSULATOR PAD TO-220	EA	1	
018	60-11-5791-1674 702028-001	18565	INSULATOR PAD	EA	1	
026	659877 659877	14482	SCHEM DIAG	EA	REF	
029	196D227X0010TE4 990018-436	56289	CAP TANT 220UF 10V 20%	EA	1	C01
030	WL659859 WL659859		WIRE LIST	EA	REF	
031	660179-002 660179-002	14482	ASSY-CABLE	EA	1	
032	MS77068-2 511030-301		LUG TERM SCR LKG NO6 MIL-C-15659	EA	3	

Figure 5-9. YIG Assembly A2 Parts List, Part No. 659859
(Sheet 2 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
033	281199-1 659650-001	14482	HEATSINK #2	EA	1	
034	281198-1 659649-001	14482	HEATSINK #1	EA	1	
035	TA1S8-M 500200-020	06383	CLAMP STRAP HOLDER	EA	1	
036	632675-023 632675-023	14482	ATTEN PAD 3DB DC-18GHZ	EA	1	AT01
			EXPLOSION FINISHED			

Figure 5-9. YIG Assembly A2 Parts List, Part No. 659859
(Sheet 3 of 3)



3 MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH BLACK INK COLOR NO. 17038 PER FED-STD-595.

2 OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

NOTES: UNLESS OTHERWISE SPECIFIED.

659651A

Figure 5-10. DAC and YIG Driver A2A1 Parts List, Part No. 659651 (Sheet 1 of 3)

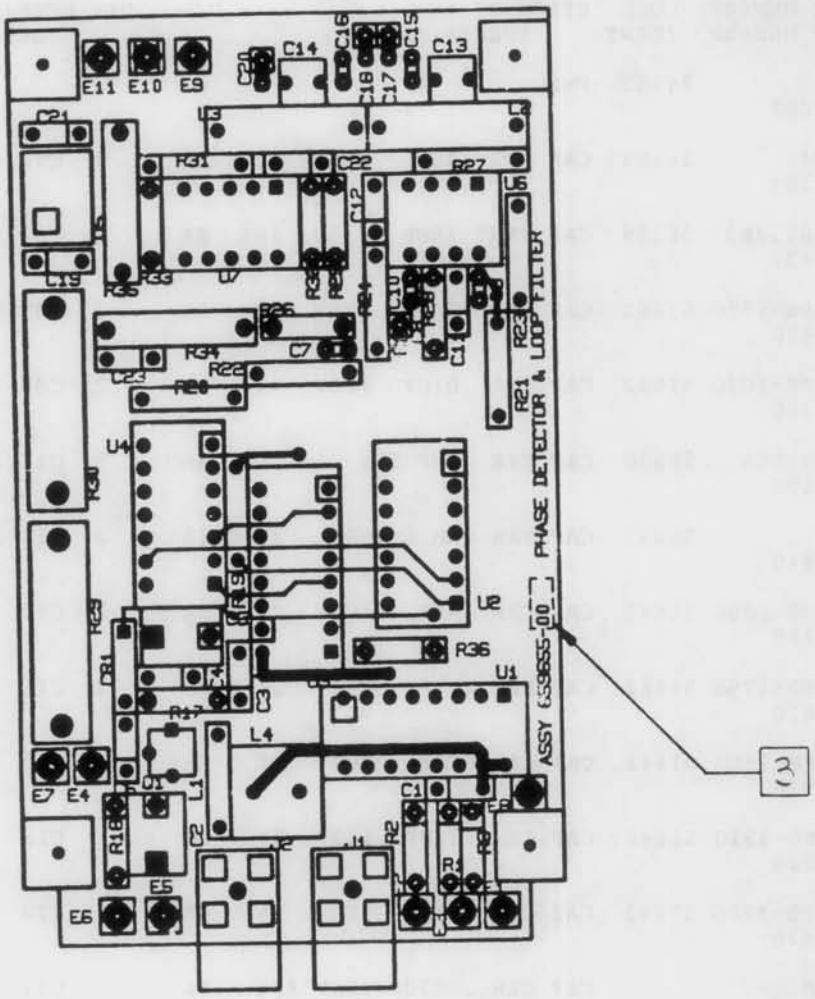
ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS Rev. B
001	659652-001 659652-001	14482	PWB	EA	1	
002	C330C105M5V5CA 752100-100	59660	CAP CER 1UF 50V	EA	9	C01-08 10
003	196D107X0020TE4 990018-435	56289	CAP TANT 100UF 20V 20%	EA	1	C09
004	196D227X0010TE4 990018-436	56289	CAP TANT 220UF 10V 20%	EA	1	C11
005	196D156X0015JE3 990018-437	56289	CAP TANT 15UF 15V 20%	EA	1	C12
006	553-3635-13-02* 760062-100	71279	COIL FIXED 10UH 20%*-00	EA	1	L01
007	CF1/8-100K/J 744055-100	09021	RES FILM 100K 1/8W 5%	EA	3	R01-03
008	CF1/8-12-0HMS/J 744051-120	09021	RES FILM 12-OHM 1/8W 5%	EA	4	R04 05 11 12
009	RN55C1002F 741554-100		RES FILM 10K 1/10W 1% MIL-R-10509	EA	2	R06 07
010	RN55C2431F 741553-243		RES FILM 2.43K 1/10W 1% MIL-R-10509	EA	1	R08
011	RN55C1821F 741553-182		RES FILM 1.82K 1/10W 1% MIL-R-10509	EA	1	R09
012	89PR50 070686-000	73138	RES VAR SCR ADJ 50-OHM	EA	1	R10
013	RN55C90R9F 741551-909		RES FILM 90.9OHM 1/10W 1% MIL-R-10509	EA	1	R13
014	CF1/4-1K/J 744073-100	09021	RES FILM 1K 1/4W 5%	EA	1	R14
015	89PR10 990018-901	73138	RES VAR SCR ADJ 10-OHM	EA	1	R15
016	627604-087 627604-087	14482	IC-4094 CT PLSTC DIP	EA	2	U01 02
017	627608-044 627608-044	14482	IC-850 CT PLSTC DIP	EA	1	U03
018	627603-326 627603-326	14482	IC-34002 CT PLSTC DIP	EA	1	U04
019	MJE800 990018-377	04713	XSTR	EA	1	U05
026	659654 659654	14482	SCHEM DIAG	EA	REF	

Figure 5-10. DAC and YIG Driver A2A1 Parts List, Part No. 659651
(Sheet 2 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
027	524-AG37D 990009-683	91506	SOCKET PC 24CONT DIP	EA	1	XU03
028	CK05BX332K 750153-330		CAP CER 3300PF 100V 10% MIL-C-11015	EA	1	C14
029	660073-101 660073-101	14482	CAP CER 100PF 50V 5%	EA	1	C13

EXPLOSION FINISHED

Figure 5-10. DAC and YIG Driver A2A1 Parts List, Part No. 659651 (Sheet 3 of 3)



3 MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH WHITE INK COLOR NO. 17875 PER FED-STD-595.

2 OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

NOTES: UNLESS OTHERWISE SPECIFIED.

659655A

Figure 5-11. Phase Detector and Loop Filter CCA A2A2 Parts List, Part No. 659655 (Sheet 1 of 3)

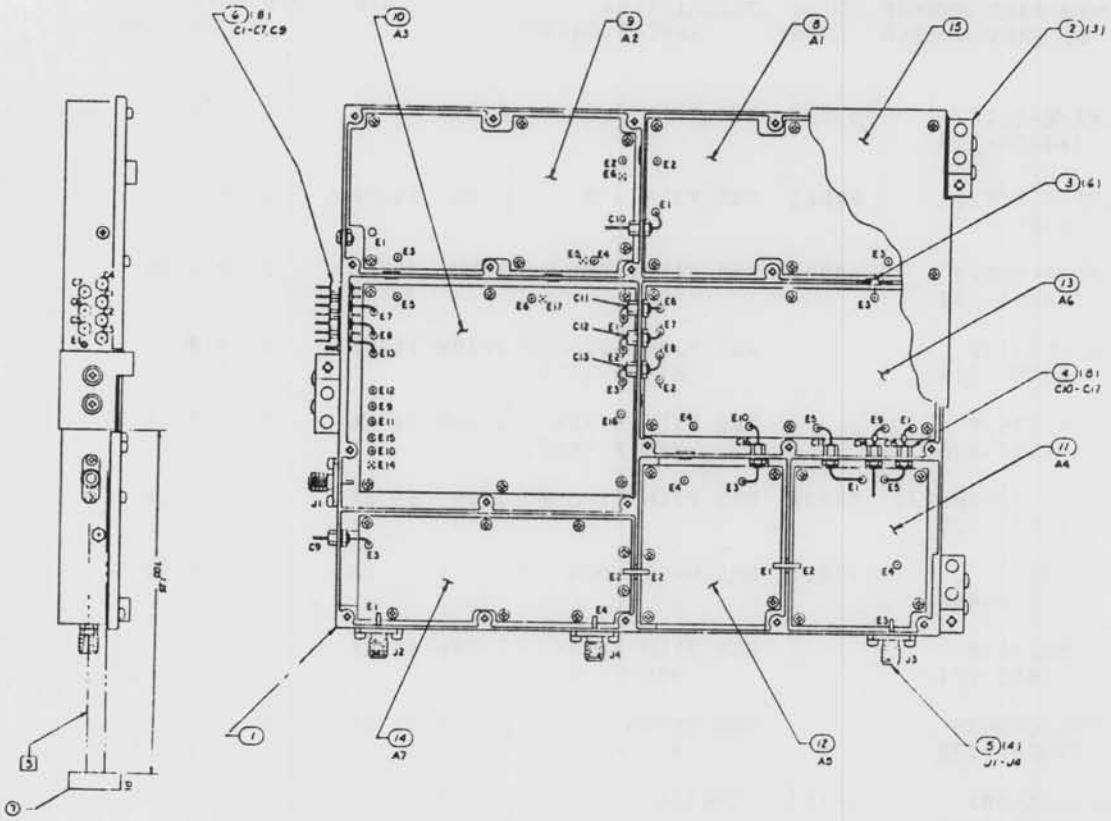
ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS (Rev. B)
001	380919-P1 659656-001	14482	PWB	EA	1	
002	660073-104 660073-104	14482	CAP CER .1UF 50V 20%	EA	4	C01 03 04 06
003	196D156X0015JE3 990018-437	56289	CAP TANT 15UF 15V 20%	EA	2	C02 05
004	150-100-NP0-471G 759162-470	51642	CAP CER 470PF 100V 2%	EA	2	C07 09
005	300-100-NP0-103G 759164-100	51642	CAP CER .01UF 100V 2%	EA	2	C08 10
006	C330C105M5V5CA 752100-100	59660	CAP CER 1UF 50V	EA	5	C11 12 19 21 22
007	9626 990018-440	91293	CAP VAR CER 6-25PF 250V	EA	2	C13 14
008	100-100-NP0-100G 759161-100	51642	CAP CER 10PF 100V 2%	EA	1	C15
009	100-100-NP0-479B 759160-470	51642	CAP CER 4.7PF 100V .1PF	EA	1	C16
010	200-100-NP0-910G 759161-910	51642	CAP CER 91PF 100V 2%	EA	1	C17
011	150-100-NP0-221G 759162-220	51642	CAP CER 220PF 100V 2%	EA	1	C18
012	150-100-NP0-470G 759161-470	51642	CAP CER 47PF 100V 2%	EA	1	C20
013	CK06BX223K 751154-220		CAP CER .022UF 100V 10% MIL-C-11015	EA	1	C23
014	1N4449 775000-001	80131	DIO HI COND HS SW 75PPV	EA	1	CR01
015	1010-7511-000 990018-442	01121	CONN SMC RT ANGLE	EA	2	J01 02
016	1025-60 760042-470	99800	COIL FIXED MOLD 47UH 10%	EA	1	L01
017	2500-28 760044-100	99800	COIL FIXED MOLD 1MILIH 5%	EA	1	L02
018	2500-04 760043-330	99800	COIL FIXED MOLD 330UH 5%	EA	1	L03
019	553-3635-33 760043-470	71279	COIL FIXED 470UH 10%	EA	1	L04
020	JAN2N2907 780000-001C		XSTR MIL-S-19500	EA	1	Q01
021	CF1/8-100K/J 744055-100	09021	RES FILM 100K 1/8W 5%	EA	3	R01-03

Figure 5-11. Phase Detector and Loop Filter CCA A2A2 Parts List, Part No. 659655 (Sheet 2 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
022	CF1/8-1.2K/J 744053-120	09021	RES FILM 1.2K 1/8W 5%	EA	1	R36
027	CF1/8-47K/J 744054-470	09021	RES FILM 47K 1/8W 5%	EA	1	R17
028	CF1/8-10K/J 744054-100	09021	RES FILM 10K 1/8W 5%	EA	2	R18 28
029	RN55C5110F 741552-511		RES FILM 511-OHM 1/10W 1% MIL-R-10509	EA	4	R19-22
030	RN55C4751F 741553-475		RES FILM 4.75K 1/10W 1% MIL-R-10509	EA	3	R23 24 27
031	CF1/8-12-OHMS/J 744051-120	09021	RES FILM 12-OHM 1/8W 5%	EA	2	R25 26
032	BWH13J 990018-448	75042	RES WW 13-OHM 2W 5%	EA	2	R29 30
033	RN55C2211F 741553-221		RES FILM 2.21K 1/10W 1% MIL-R-10509	EA	1	R31
034	RCR20G220JS 740201-220		RES CMPSN 22-OHM 1/2W 5% MIL-R-39008	EA	2	R34 35
035	627604-087 627604-087	14482	IC-4094 CT PLSTC DIP	EA	1	U01
036	627607-109 627607-109	14482	IC-7408 CT PLSTC DIP	EA	1	U02
037	627607-266 627605-300A	14482	IC-74LS157 CT PLSTC DIP	EA	1	U03
038	627604-085 627604-085	14482	IC-4044 CT PLSTC DIP	EA	1	U04
039	627607-611 627607-611	14482	IC-7905 CT SPCL PKG	EA	1	U05
040	627601-232 627601-232	14482	IC-1007 CT PLSTC DIP	EA	1	U06
041	627602-003 627602-003	14482	IC-0002 CT PLSTC DIP	EA	1	U07
052	659658 659658	14482	SCHEM DIAG	EA	REF	
053	CF1/8-1.5K/J 744053-150	09021	RES FILM 1.5K 1/8W 5%	EA	2	R32 33

EXPLOSION FINISHED

Figure 5-11. Phase Detector and Loop Filter CCA A2A2 Parts List, Part No. 659655 (Sheet 3 of 3)



[3] SEE WIRE LIST WL 659901.

2. REFERENCE DESIGNATIONS ARE FOR REFERENCE ONLY AND MAY OR MAY NOT APPEAR ON PART.

1. SOLDER PER MIL-STD-454 REQUIREMENTS.

NOTES: UNLESS OTHERWISE SPECIFIED.

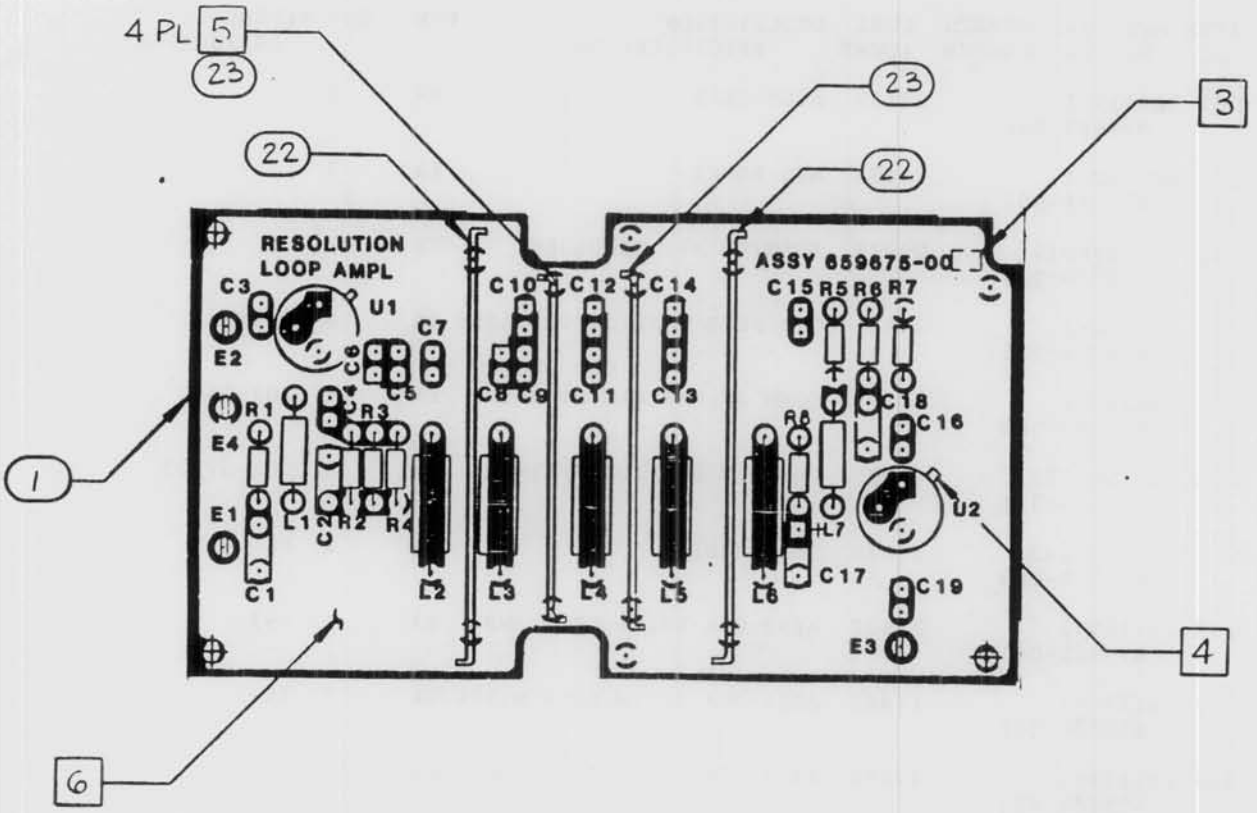
659901A

Figure 5-12. Second LO Synthesizer A3 Parts List, Part No. 659901 (Sheet 1 of 2)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
001	580517-1 / 659659-001	14482	ASSY-CHAS	EA	1	
002	281342-1 / 659748-001	14482	MTG BLOCK	EA	3	
003	B51547F015 / 500060-013	04713	BUSHING NYL SHOULDER	EA	6	
004	281216-2 / 659674-002	14482	CAP FEED THRU 1000PF 100V	EA	8	C10-17
005	OSM244-2 / 090939-000	16179	CONN JK SMA FLG MT 2HOLE	EA	4	J01-04
006	54-790-018 / 990018-324	33095	CAP F/T EMI 1000PF 100V	EA	8	C01-07 09
007	660179-003 / 660179-003	14482	ASSY-CABLE	EA	1	P01
008	281169-1 / 659675-001	14482	ASSY-CCA RSLTN LOOP AMPL	EA	1	A01
009	281170-1 / 659870-001	14482	ASSY-CCA RSLTN LOOP MIXER	EA	1	A02
010	281171-1 / 659684-001	14482	ASSY-CCA RESOLUTION LOOP	EA	1	A03
011	281172-1 / 659688-001	14482	ASSY-CCA XLTN LOOP VCO	EA	1	A04
012	281173-1 / 659694-001	14482	ASSY-CCA XLTN LOOP MIXER	EA	1	A05
013	281174-1 / 659698-001	14482	ASSY-CCA XLTN LOOP PHASE	EA	1	A06
014	281175-1 / 659702-001	14482	ASSY-CCA 50-1050MHZ	EA	1	A07
015	580512-1 / 659706-001	14482	COVER	EA	1	
017	WL659901 / WL659901	14482	WIRE LIST	EA	REF	
026	580347 / 659902	14482	SCHEM DIAG	EA	REF	

EXPLOSION FINISHED

Figure 5-12. Second LO Synthesizer A3 Parts List, Part No. 659901 (Sheet 2 of 2)



6 ASSY SIDE IS GROUND PLANE, SHOWN IN NEGATIVE FOR CLARITY ONLY.

5 SOLDER ITEMS 22 AND 23 TO GROUND PLANE

4 SOLDER TAB OF U1 AND U2 TO GROUND PLANE.

3 MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH BLACK INK COLOR NO. 17038 PER FED-STD-595.

2 OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

NOTES: UNLESS OTHERWISE SPECIFIED.

659675A

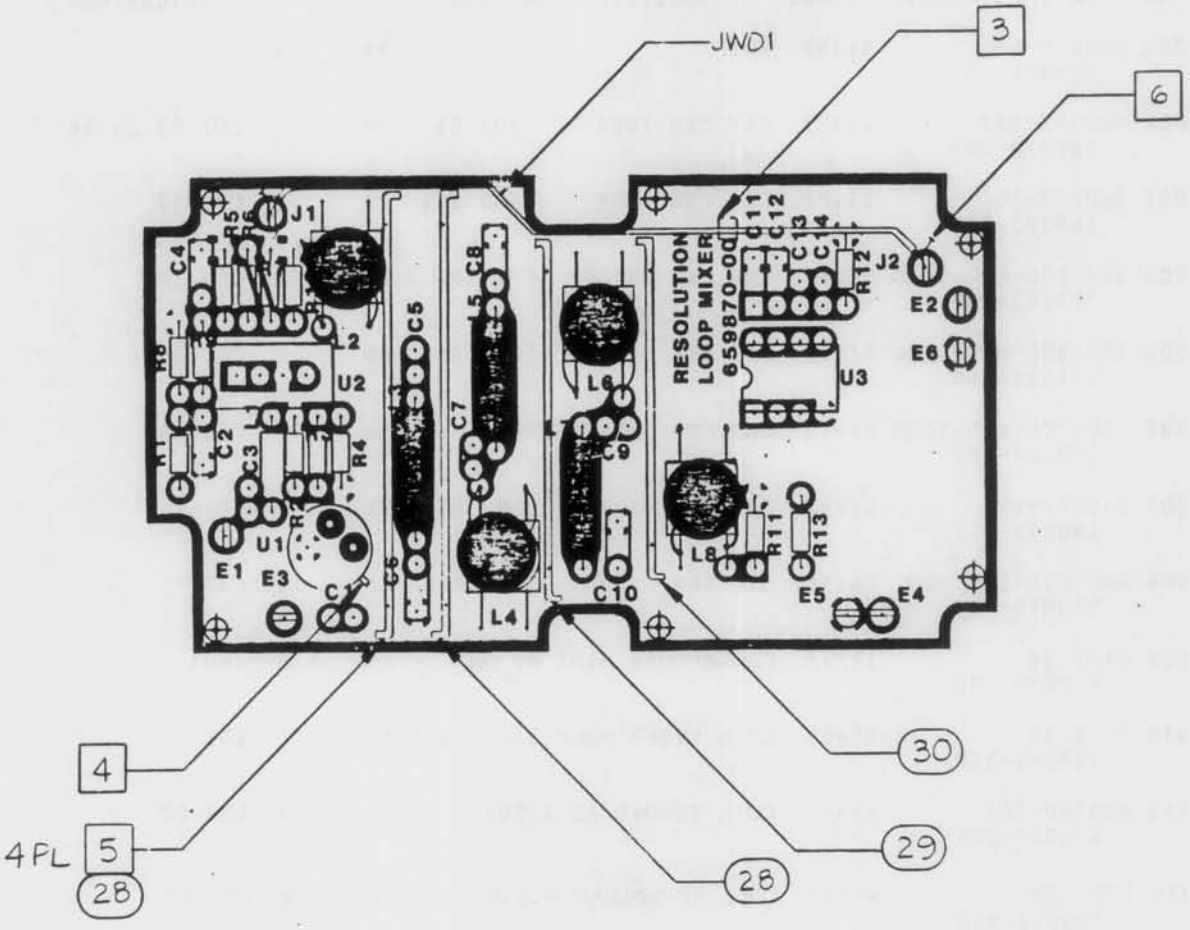
Figure 5-13. Resolution Loop Amplifier CCA A3A1 Parts List, Part No. 659675 (Sheet 1 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS (Rev. B)
001	659676-001 659676-001	14482	PWB	EA	1	
002	660073-104 660073-104	14482	CAP CER .1UF 50V 20%	EA	3	C01 02 18
003	660073-102 660073-102	14482	CAP CER 1000PF 50V 5%	EA	4	C03 04 16 19
004	660073-121 660073-121	14482	CAP CER 120PF 50V 5%	EA	1	C05
005	660073-331 660073-331	14482	CAP CER 330PF 50V 5%	EA	1	C06
006	660073-390 660073-390	14482	CAP CER 39PF 50V 5%	EA	2	C07 13
007	660073-301 660073-301	14482	CAP CER 300PF 50V 5%	EA	3	C08 10 12
008	100-100-NP0-240G 759161-240	51642	CAP CER 24PF 100V 2%	EA	2	C09 11
009	660073-271 660073-271	14482	CAP CER 270PF 50V 5%	EA	1	C14
010	660073-151 660073-151	14482	CAP CER 150PF 50V 5%	EA	1	C15
011	MML-015-156R-20 990018-489	14674	CAP TANT 15UF 15V 20%	EA	1	C17
012	1025-44 760042-100	99800	COIL FIXED MOLD 10UH 10%	EA	1	L01
013	L10-0R383 760040-383	7W259	COIL FXD .383UH 1%	EA	2	L02 06
014	L10-0R464 760040-464	7W259	COIL FXD .464UH 1%	EA	2	L03 05
015	L10-0R470 760040-470	7W259	COIL FXD .470UH 1%	EA	1	L04
016	1025-36 760041-470	99800	COIL FIXED MOLD 4.7UH 10%	EA	1	L07
017	CF1/8-200-0HMS/J 744052-200	09021	RES FILM 200-OHM 1/8W 5%	EA	1	R01
018	CF1/8-560-0HMS/J 744052-560	09021	RES FILM 560-OHM 1/8W 5%	EA	4	R02 04 05 07
019	CF1/8-10-0HMS/J 744051-100	09021	RES FILM 10-OHM 1/8W 5%	EA	2	R03 06
020	CF1/8-180-0HMS/J 744052-180	09021	RES FILM 180-OHM 1/8W 5%	EA	1	R08
021	627601-034 627601-034	14482	IC-110 MT MET CAN	EA	2	U01 02

Figure 5-13. Resolution Loop Amplifier CCA A3A1 Parts List, Part No. 659675 (Sheet 2 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
022	659679-001 659679-001	14482	SHIELD	EA	2	
023	659680-001 659680-001	14482	SHIELD #4	EA	2	
026	659678 659678	14482	SCHEM DIAG	EA	REF	
			EXPLOSION FINISHED			

Figure 5-13. Resolution Loop Amplifier CCA A3A1 Parts List, Part No. 659675 (Sheet 3 of 3)



6 SOLDER SHIELD DRAIN WIRE JW01 TO GROUND PLANE BOTH ENDS.

5 SOLDER ITEMS 28, 29 AND 30 TO GROUND PLANE.

4 SOLDER TAB OF U1 TO GROUND PLANE.

3 MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH BLACK INK COLOR NO. 17038 PER FED-STD-595.

2 OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

NOTES: UNLESS OTHERWISE SPECIFIED.

659870C

Figure 5-14. Resolution Loop Mixer CCA A3A2 Parts List, Part No. 659870 (Sheet 1 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS (Rev. A)
001	659871-001 659871-001	14482	PWB	EA	1	
002	660073-102 660073-102	14482	CAP CER 1000PF 50V 5%	EA	4	C01 03 13 14
003	660073-104 660073-104	14482	CAP CER .1UF 50V 20%	EA	2	C02 12
004	300-100-NP0-362G 759163-360	51642	CAP CER 3600PF 100V 2%	EA	2	C04 10
005	150-100-NP0-561G 759162-560	51642	CAP CER 560PF 100V 2%	EA	2	C05 09
006	300-100-NP0-562G 759163-560	51642	CAP CER 5600PF 100V 2%	EA	2	C06 08
007	660073-471 660073-471	14482	CAP CER 470PF 50V 5%	EA	1	C07
008	MML-015-156R-20 990018-489	14674	CAP TANT 15UF 15V 20%	EA	1	C11
009	CXN1214 450010-008	17217	CABLE COAX MINI 50-OHM	FT	A/R	JW01
010	1025-48 760042-150	99800	COIL FIXED MOLD 15UH 10%	EA	1	L01
011	660060-001 660060-001	14482	COIL TOROID AL 1.5UH	EA	2	L02 08
012	1537-34 760051-820	99800	COIL RF MOLDED 8.2UH 10%	EA	2	L03 07
013	660060-002 660060-002	14482	COIL TOROID AL .85UH	EA	2	L04 06
014	1537-36 760052-100	99800	COIL RF MOLDED 10UH 10%	EA	1	L05
015	CF1/8-36-OHMS/J 744051-360	09021	RES FILM 36-OHM 1/8W 5%	EA	1	R01
016	CF1/8-300-OHMS/J 744052-300	09021	RES FILM 300-OHM 1/8W 5%	EA	4	R02 04 05 07
017	CF1/8-18-OHMS/J 744051-180	09021	RES FILM 18-OHM 1/8W 5%	EA	2	R03 06
018	CF1/8-180-OHMS/J 744052-180	09021	RES FILM 180-OHM 1/8W 5%	EA	2	R08 10
019	CF1/8-30-OHMS/J 744051-300	09021	RES FILM 30-OHM 1/8W 5%	EA	1	R09
020	CF1/8-47-OHMS/J 744051-470	09021	RES FILM 47-OHM 1/8W 5%	EA	1	R11
021	CF1/8-100K/J 744055-100	09021	RES FILM 100K 1/8W 5%	EA	1	R12

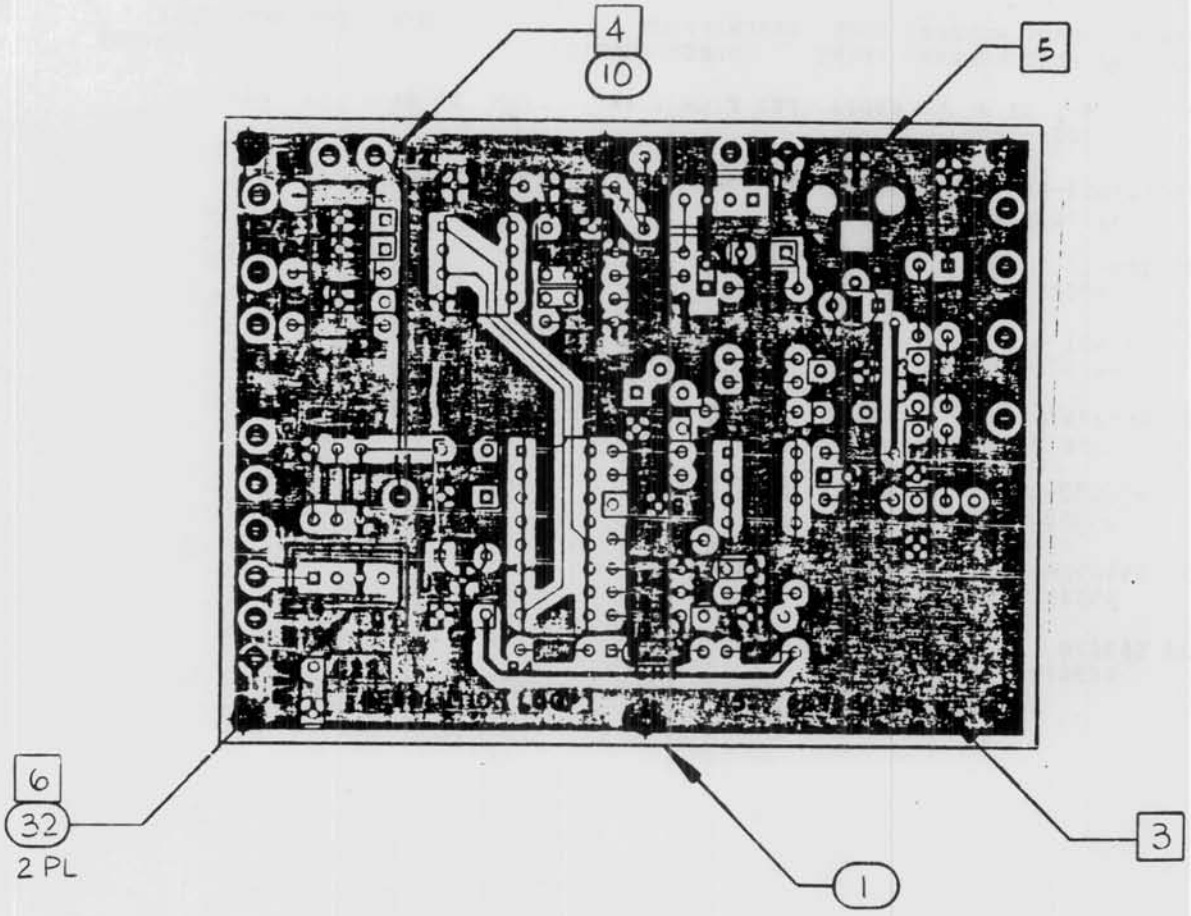
Figure 5-14. Resolution Loop Mixer CCA A3A2 Parts List, Part No. 659870 (Sheet 2 of 3)

ASSEMBLY NO: 659870-001 ASSY-CCA RSLTN LOOP MIXER REV.

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
022	CF1/8-1.8K/J 744053-180	09021	RES FILM 1.8K 1/8W 5%	EA	1	R13
025	627602-027 627602-027	14482	IC-220 CT MET CAN	EA	1	U01
026	TFM-2 990018-612	15542	MIXER	EA	1	U02
027	627601-436 627601-436	14482	IC-12023 CT PLSTC DIP	EA	1	U03
028	659679-001 659679-001	14482	SHIELD	EA	2	
029	659692-001 659692-001	14482	SHIELD	EA	1	
030	659692-002 659692-002	14482	SHIELD	EA	1	
039	659678 659678	14482	SCHEM DIAG	EA	REF	

EXPLOSION FINISHED

Figure 5-14. Resolution Loop Mixer CCA A3A2 Parts List, Part No. 659870 (Sheet 3 of 3)



[6] BLUE BEAD ON COMPONENT INDICATES PIN 1.

[5] SOLDER CASE OF U6 TO GROUND PLANE.

[4] SOLDER OUTER CONDUCTOR DRAIN WIRE TO GROUND-BOTH ENDS.

[3] MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH BLACK INK COLOR NO. 17038 PER FED-STD-595.

2. OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

NOTES: UNLESS OTHERWISE SPECIFIED.

659684D

Figure 5-15. Resolution Loop CCA A3A3 Parts List, Part No. 659684 (Sheet 1 of 3)

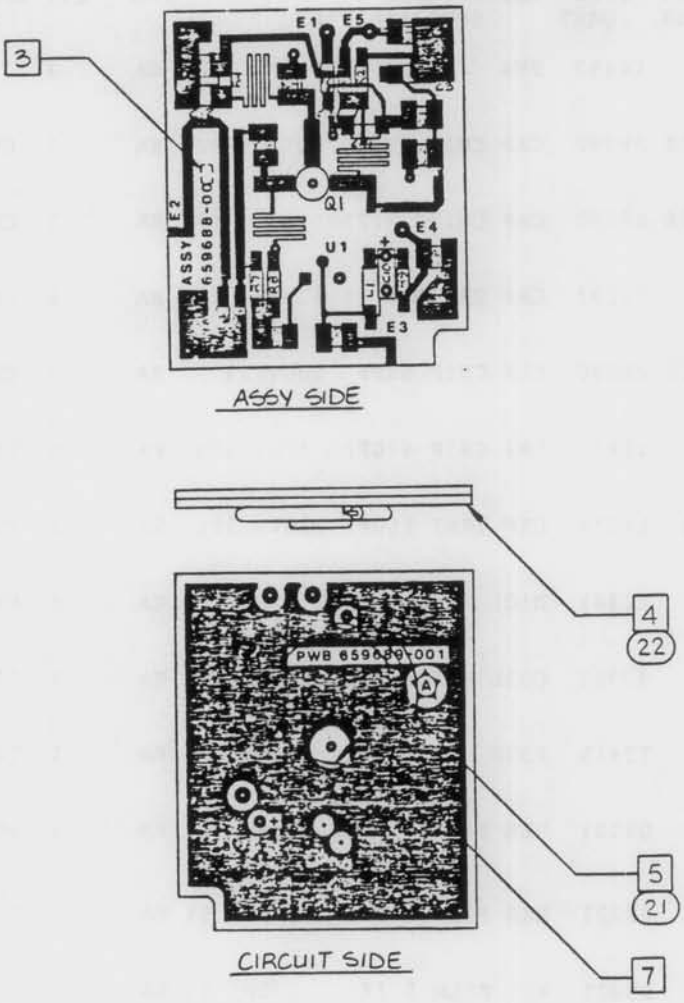
ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
						Rev. C
001	659685-001 659685-001	14482	PWB	EA	1	
002	660073-103 660073-103	14482	CAP CER .01UF 50V 20%	EA	4	C01 02 12 13
003	660073-104 660073-104	14482	CAP CER .1UF 50V 20%	EA	5	C03 05 06 15 22
004	MMS-020-156R-20 990018-426	14674	CAP TANT 15UF 20V 20%	EA	5	C04 14 18-20
005	CK06BX473K 751154-470		CAP CER .047UF 100V 10% MIL-C-11015	EA	1	C11
006	660073-474 660073-474	14482	CAP CER .47UF 50V 20%	EA	2	C07 10
007	MMF-020-105R-20 990018-536	14674	CAP TANT 1UF 20V 20%	EA	3	C08 09 21
008	660073-102 660073-102	14482	CAP CER 1000PF 50V 5%	EA	2	C16 17
009	1N4449 775000-001	80131	DIO HI COND HS SW 75PPV	EA	2	CR01 02
010	CXN1214 450010-008	17217	CABLE COAX MINI 50-OHM	FT	AR	JW01
011	1025-28 760041-220	99800	COIL FIXED MOLD 2.2UH 10%	EA	1	L01
012	1025-52 760042-220	99800	COIL FIXED MOLD 22UH 10%	EA	2	L02 03
013	CF1/8-560-0HMS/J 744052-560	09021	RES FILM 560-OHM 1/8W 5%	EA	6	R01 03 08 09 12 18
014	CF1/8-10-0HMS/J 744051-100	09021	RES FILM 10-OHM 1/8W 5%	EA	3	R02 14 16
015	CF1/8-10K/J 744054-100	09021	RES FILM 10K 1/8W 5%	EA	4	R04-07
016	3262W-1-501 990018-538	32997	RES VAR SCR ADJ 500-OHM	EA	1	R10
017	CF1/8-300-0HMS/J 744052-300	09021	RES FILM 300-OHM 1/8W 5%	EA	1	R11
018	RN55C6810F 741552-681		RES FILM 681-OHM 1/10W 1% MIL-R-10509	EA	2	R13 15
019	CF1/8-200-0HMS/J 744052-200	09021	RES FILM 200-OHM 1/8W 5%	EA	1	R17
020	CF1/8-2.7K/J 744053-270	09021	RES FILM 2.7K 1/8W 5%	EA	1	R19
021	CF1/8-12K/J 744054-120	09021	RES FILM 12K 1/8W 5%	EA	2	R20 29

Figure 5-15. Resolution Loop CCA A3A3 Parts List, Part No. 659684 (Sheet 2 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
022	CF1/8-68-OHMS/J 744051-680	09021	RES FILM 68-OHM 1/8W 5%	EA	2	R22 24
023	CF1/8-150-OHMS/J 744052-150	09021	RES FILM 150-OHM 1/8W 5%	EA	1	R23
024	CF1/8-56-OHMS/J 744051-560	09021	RES FILM 56-OHM 1/8W 5%	EA	2	R26 27
025	CF1/8-220-OHMS/J 744052-220	09021	RES FILM 220-OHM 1/8W 5%	EA	1	R28
026	TSC-2-1 990018-624	15542	PWR SPLTR 1-400MHZ 2WAY	EA	2	U01 05
027	627601-263 627601-263	14482	IC-145158 IT PLSTC DIP	EA	1	U02
028	627601-232 627601-232	14482	IC-1007 CT PLSTC DIP	EA	1	U03
029	627601-433 627601-433	14482	IC-12017 CT PLSTC DIP	EA	1	U04
030	VCO-104 990018-614	05375	OSC VOLT CONT 100-200MHZ	EA	1	U06
031	627607-694 627607-694	14482	IC-78L05 CT MET CAN	EA	1	U07
032	660068-001 660068-001	14482	INSULATOR	EA	2	XU01 05
033	2N4401 780000-022		XSTR NPN GEN PURPOSE	EA	1	Q01
039	659678 659678	14482	SCHEM DIAG	EA	REF	
040	CF1/8-100K/J 744055-100	09021	RES FILM 100K 1/8W 5%	EA	2	R21 25
041	CF1/8-1K/J 744053-100	09021	RES FILM 1K 1/8W 5%	EA	1	R30

EXPLOSION FINISHED

Figure 5-15. Resolution Loop CCA A3A3 Parts List, Part No. 659684 (Sheet 3 of 3)



[8] USE ITEM 28 TO SOLDER ALL CHIP COMPONENTS.

[7] DO NOT SOLDER CENTER OF ITEM 21 TO PWB.

6 MAXIMUM COMPONENT HEIGHT ABOVE BOARD 0.340.

[5] TACK SOLDER ALONG EDGE OF W1, ITEM 21 TO GROUND PLATE.

[4] SOLDER GROUND PLATE, ITEM 22 TO CIRCUIT SIDE OF BOARD BEFORE INSTALLING COMPONENTS.

[3] MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH BLACK INK COLOR NO. 17038 PER FED-STD-595.

2. OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

NOTES: UNLESS OTHERWISE SPECIFIED.

659688A

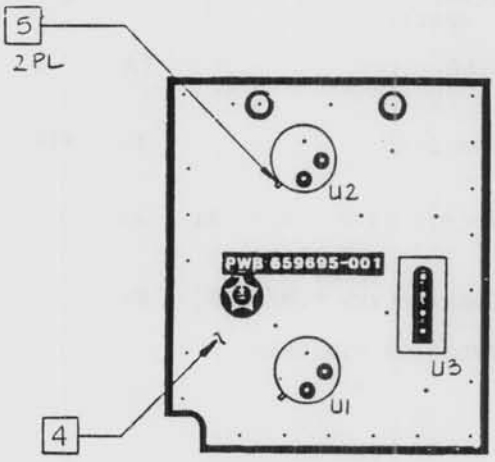
Figure 5-16. Translation Loop VCO CCA A3A4 Parts List, Part No. 659688 (Sheet 1 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS Rev. B
001	659689-001 659689-001	14482	PWB	EA	1	
003	ATC100B1R0BP500X 990018-509	29990	CAP CHIP 1PF 500V .1PF	EA	1	C01
004	ATC100B6R2BP500X 990018-696	29990	CAP CHIP6.2PF500V+/-.1PF	EA	1	C02
005	27271SL 990018-508	91293	CAP VAR AIR .6-4.5PF	EA	1	C03
006	ATC100B680GP500X 990018-512	29990	CAP CHIP 68PF 500V 2%	EA	2	C04 06
007	C1210E471K1GAH 756152-470	31433	CAP CHIP 470PF 100V 10%	EA	6	C05 07-09 11 13
008	MML-015-156R-20 990018-489	14674	CAP TANT 15UF 15V 20%	EA	1	C10
009	MA-46533C 990018-506	96341	DIO	EA	1	CR01
010	1025-20 760041-100	99800	COIL FIXED MOLD 1UH 10%	EA	1	L01
011	BFR96 990018-505	73445	XSTR	EA	1	Q01
012	CF1/8-51K/J 744054-510	09021	RES FILM 51K 1/8W 5%	EA	1	R01
013	CF1/8-8.2K/J 744053-820	09021	RES FILM 8.2K 1/8W 5%	EA	1	R02
014	CF1/8-5.1K/J 744053-510	09021	RES FILM 5.1K 1/8W 5%	EA	1	R03
015	CF1/8-180-OHMS/J 744052-180	09021	RES FILM 180-OHM 1/8W 5%	EA	1	R04
016	CF1/8-51-OHMS/J 744051-510	09021	RES FILM 51-OHM 1/8W 5%	EA	1	R05
017	CF1/8-56-OHMS/J 744051-560	09021	RES FILM 56-OHM 1/8W 5%	EA	3	R06 08 09
018	CF1/8-240-OHMS/J 744052-240	09021	RES FILM 240-OHM 1/8W 5%	EA	1	R07
020	GPD321 990018-629	24539	AMPL RF	EA	1	U01
021	659693-001 659693-001	14482	ASSY-CABLE	EA	1	W01

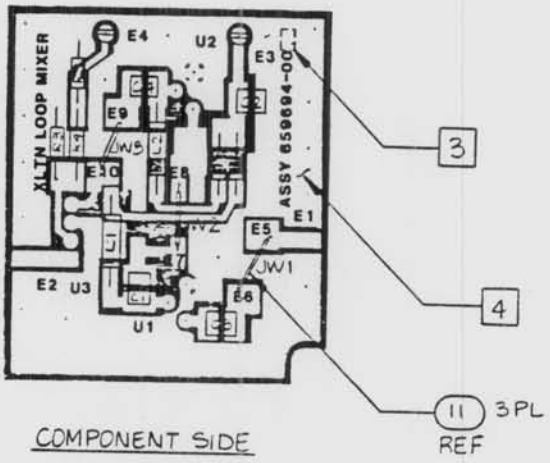
Figure 5-16. Translation Loop VCO CCA A3A4 Parts List, Part No. 659688 (Sheet 2 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
022	659682-001 659682-001	14482	SHIELD	EA	1	
026	659678 659678	14482	SCHEM DIAG	EA	REF	
027	652540-009 652540-009	14482	CAP CHIP 18PF 50V 5%	EA	1	C12
028	4S/60T-36L 082337-000	74858	SOLDER SILVER TIN/LEAD	EA	AR	
			EXPLOSION FINISHED			

Figure 5-16. Translation Loop VCO CCA A3A4 Parts List, Part No. 659688 (Sheet 3 of 3)



CIRCUIT SIDE



COMPONENT SIDE

[5] SOLDER TABS ON U1 AND U2 TO GROUND PLANE.

[4] BOTH SIDES ARE GROUND PLANE, BOTH SIDES SHOWN IN NEGATIVE FOR CLARITY ONLY.

[3] MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH BLACK INK COLOR NO. 17038 PER FED-STD-595.

2 OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

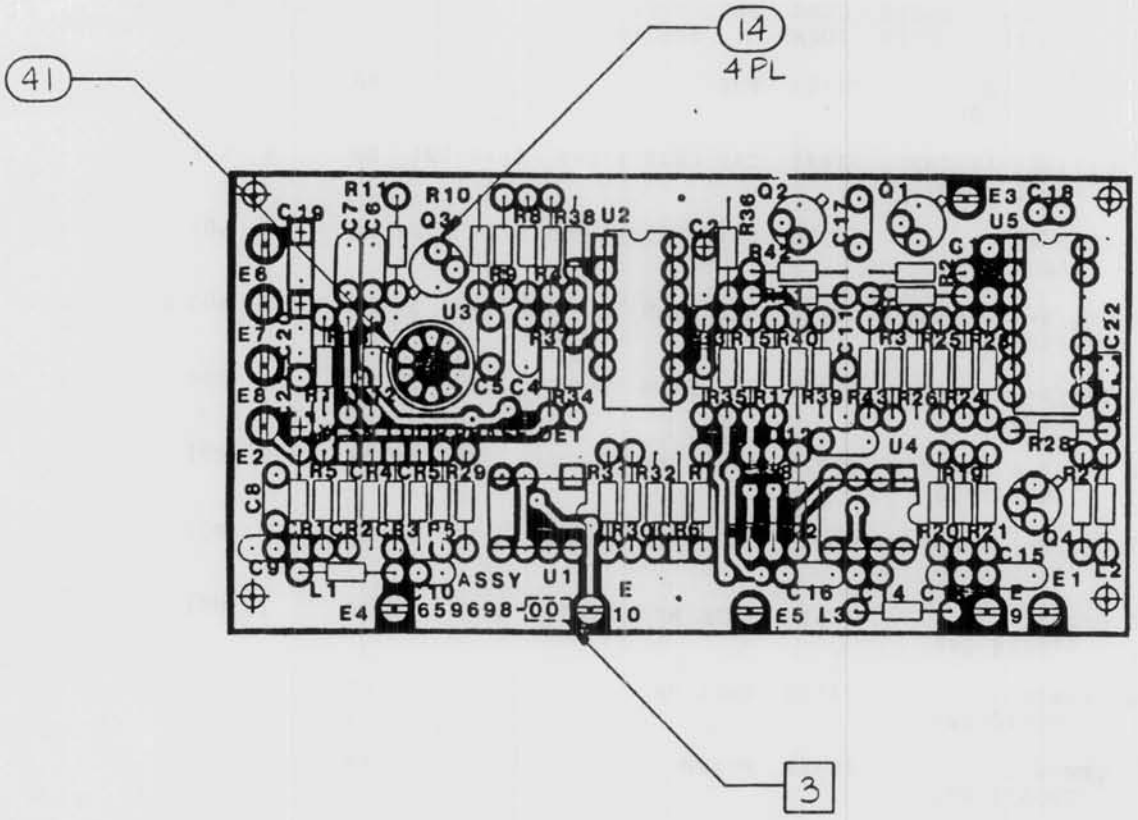
NOTES: UNLESS OTHERWISE SPECIFIED.

659694

Figure 5-17. Translation Loop Mixer CCA A3A5 Parts List, Part No. 659694 (Sheet 1 of 2)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
001	659695-001 659695-001	14482	PWB	EA	1	
002	C1210E471K1GAH 756152-470	31433	CAP CHIP 470PF 100V 10%	EA	4	C01-04
003	1025-44 760042-100	99800	COIL FIXED MOLD 10UH 10%	EA	2	L01 02
004	CF1/8-300-OHMS/J 744052-300	09021	RES FILM 300-OHM 1/8W 5%	EA	2	R03 05
005	CF1/8-18-OHMS/J 744051-180	09021	RES FILM 18-OHM 1/8W 5%	EA	1	R04
006	CF1/8-62-OHMS/J 744051-620	09021	RES FILM 62-OHM 1/8W 5%	EA	1	R01
007	CF1/8-15-OHMS/J 744051-150	09021	RES FILM 15-OHM 1/8W 5%	EA	1	R02
008	GPD321 990018-629	24539	AMPL RF	EA	1	U01
009	GPD430 990018-627	24539	AMPL RF	EA	1	U02
010	TFM-4 990018-613	15542	MIXER	EA	1	U03
011	22AWG-QQW343 442222-000		WIRE BUS SOLID TINNED CU QQ-W-343	FT	A/R	JW01-03
013	659678 659678	14482	SCHEM DIAG	EA	REF	
			EXPLOSION FINISHED			

Figure 5-17. Translation Loop Mixer CCA A3A5 Parts List, Part No. 659694 (Sheet 2 of 2)



[3] MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH BLACK INK COLOR NO. 17038 PER FED-STD-595.

2. OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

NOTES: UNLESS OTHERWISE SPECIFIED.

659698A

Figure 5-18. Translation Loop Phase CCA A3A6 Parts List, Part No. 659698 (Sheet 1 of 3)

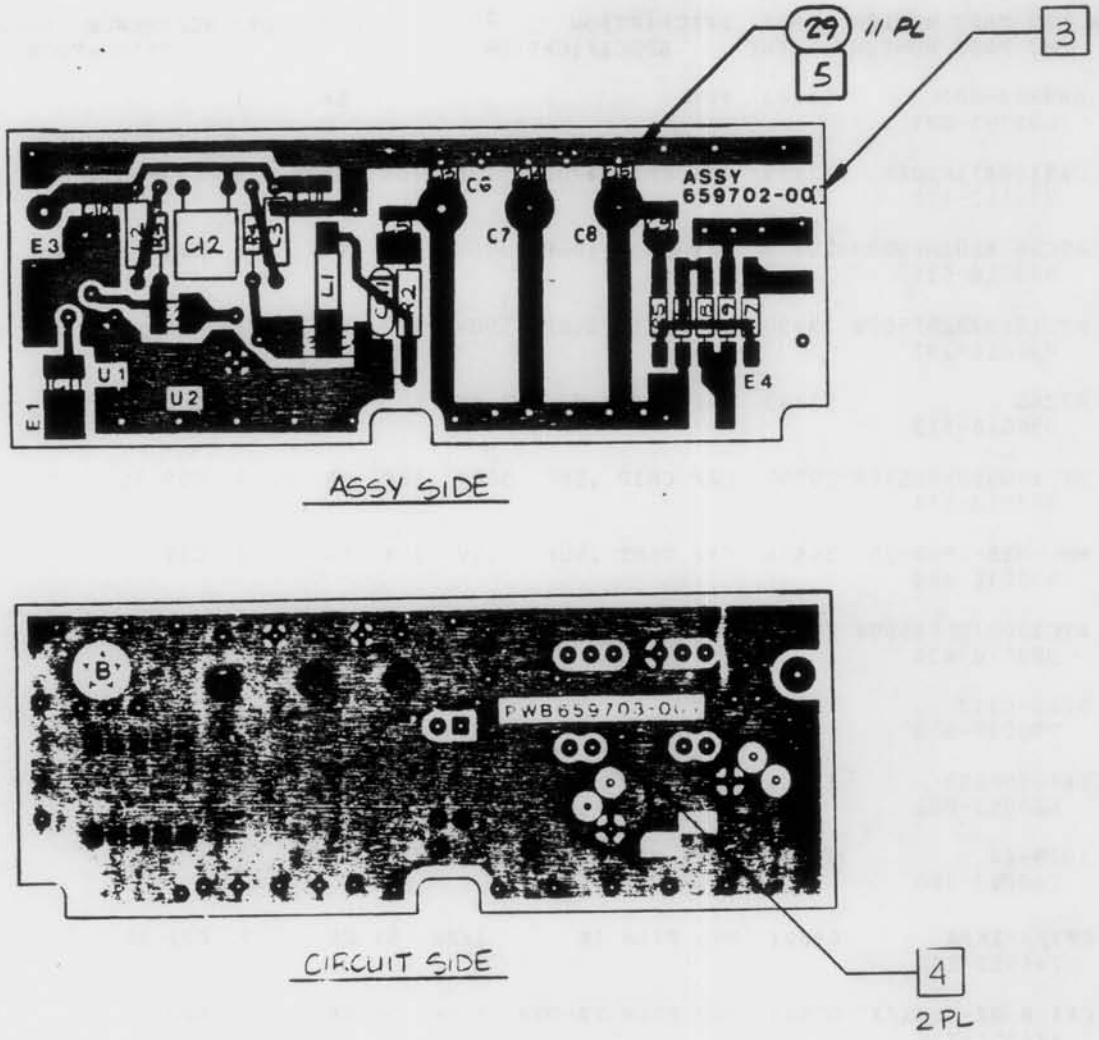
ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS Rev. A
001	659699-001 659699-001	14482	PWR	EA	1	
002	660073-104 660073-104	14482	CAP CER .1UF 50V 20%	EA	7	C01 05 07 08 15-17
003	MMS-020-156R-20 990018-426	14674	CAP TANT 15UF 20V 20%	EA	4	C02 19-21
004	660073-474 660073-474	14482	CAP CER .47UF 50V 20%	EA	2	C04 06
006	150-100-NP0-221G 759162-220	51642	CAP CER 220PF 100V 2%	EA	2	C13 14
007	660073-101 660073-101	14482	CAP CER 100PF 50V 5%	EA	1	C18
008	MMM-025-225R-20 990018-521	14674	CAP TANT 2.2UF 25V 20%	EA	1	C22
009	1N4449 775000-001	80131	DIO HI COND HS SW 75PPV	EA	6	CR01-06
010	1025-20 760041-100	99800	COIL FIXED MOLD 1UH 10%	EA	1	L01
011	1025-52 760042-220	99800	COIL FIXED MOLD 22UH 10%	EA	2	L02 03
012	2N2369 780000-026	80131	XSTR NPN LOW PWR HI-SPD	EA	3	Q01-03
013	2N2907 780000-001A		XSTR PNP HI-SPD MED PWR	EA	1	Q04
014	10091 702021-005	07047	INSULATOR PAD	EA	4	
015	CF1/8-8.2K/J 744053-820	09021	RES FILM 8.2K 1/8W 5%	EA	3	R01 09 41
016	CF1/8-5.1K/J 744053-510	09021	RES FILM 5.1K 1/8W 5%	EA	5	R02 10 16 18 42
017	CF1/8-470-OHMS/J 744052-470	09021	RES FILM 470-OHM 1/8W 5%	EA	4	R03 08 11 43
018	CF1/8-2.7-OHMS/J 744050-270	09021	RES FILM 2.7-OHM 1/8W 5%	EA	1	R04
019	CF1/8-22K/J 744054-220	09021	RES FILM 22K 1/8W 5%	EA	7	R05 06 15 17 29 31 32
020	CF1/8-100-OHMS/J 744052-100	09021	RES FILM 100-OHM 1/8W 5%	EA	1	R07
021	CF1/8-2K/J 744053-200	09021	RES FILM 2K 1/8W 5%	EA	3	R12 14 27
022	CF1/8-51-OHMS/J 744051-510	09021	RES FILM 51-OHM 1/8W 5%	EA	1	R13

Figure 5-18. Translation Loop Phase CCA A3A6 Parts List, Part No. 659698 (Sheet 2 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
024	CF1/8-47K/J 744054-470	09021	RES FILM 47K 1/8W 5%	EA	2	R19 20
025	CF1/8-47-OHMS/J 744051-470	09021	RES FILM 47-OHM 1/8W 5%	EA	2	R21 22
026	CF1/8-3.3K/J 744053-330	09021	RES FILM 3.3K 1/8W 5%	EA	5	R23 24 30 33 34
027	RN55C1001F 741553-100		RES FILM 1K 1/10W 1% MIL-R-10509	EA	1	R25
028	RN55C2211F 741553-221		RES FILM 2.21K 1/10W 1% MIL-R-10509	EA	1	R26
029	CF1/8-10-OHMS/J 744051-100	09021	RES FILM 10-OHM 1/8W 5%	EA	1	R28
030	CF1/8-1.5K/J 744053-150	09021	RES FILM 1.5K 1/8W 5%	EA	2	R35 37
031	CF1/8-6.8K/J 744053-680	09021	RES FILM 6.8K 1/8W 5%	EA	2	R36 38
032	CF1/8-510-OHMS/J 744052-510	09021	RES FILM 510-OHM 1/8W 5%	EA	2	R39 40
033	627603-223 627603-223	14482	IC-358 CT PLSTC DIP	EA	1	U01
034	627601-440 627601-440	14482	IC-12040 MT CER DIP	EA	1	U02
035	627607-306 627607-306	14482	IC-733 MT MET CAN	EA	1	U03
036	627601-232 627601-232	14482	IC-1007 CT PLSTC DIP	EA	1	U04
037	627607-040 627607-040	14482	IC-723 CT PLSTC DIP	EA	1	U05
039	659678 659678	14482	SCHEM DIAG	EA	REF	
040	660073-201 660073-201	14482	CAP CER 200PF 50V 5%	EA	4	C09-12
041	606-075 702021-004	32559	INSULATOR PAD	EA	1	XU03

EXPLOSION FINISHED

Figure 5-18. Translation Loop Phase CCA A3A6 Parts List, Part No. 659698 (Sheet 3 of 3)



[5] SOLDER ALL CHIP CAPACITORS USING SILVER SOLDER, ITEM 29.

[4] SOLDER TABS OF U1 AND U2 TO GROUND PLANE.

[3] MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH BLACK INK COLOR NO. 17038 PER FED-STD-595.

2 OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

NOTES: UNLESS OTHERWISE SPECIFIED.

659702A

Figure 5-19. 50 to 1050 MHz CCA A3A7 Parts List, Part No. 659702 (Sheet 1 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS Rev. A	
001	659703-001 659703-001	14482	PWB	EA	1		
002	C1210E471K1GAH 756152-470	31433	CAP CHIP 470PF 100V 10%	EA	5	C01-03 10 11	
003	ATC100B101MP500X 990018-515	29990	CAP CHIP 100PF 500V 20%	EA	1	C04	
004	ATC100B2R2BP500X 990018-397	29990	CAP CHIP 2.2PF 500V .1PF	EA	1	C05	
005	27265 990018-513	91293	CAP VAR AIR .3-1.2PF	EA	3	C06-08	
006	ATC100B0R5BP500X 990018-514	29990	CAP CHIP .5PF 500V .1PF	EA	2	C09 15	
007	MML-015-156R-20 990018-489	14674	CAP TANT 15UF 15V 20%	EA	1	C12	
008	ATC100B1R5CP500X 990018-430	29990	CAP CHIP1.5PF500V+/-.25PF	EA	1	C14	
009	5082-0112 990018-518	28480	DIO	EA	1	CR01	
010	660059-001 660059-001	14482	INDUCTOR AIR CORE 70NH	EA	1	L01	
011	1025-44 760042-100	99800	COIL FIXED MOLD 10UH 10%	EA	2	L02 03	
012	CF1/8-1K/J 744053-100	09021	RES FILM 1K 1/8W 5%	EA	2	R01 08	
013	CF1/8-22-0HMS/J 744051-220	09021	RES FILM 22-OHM 1/8W 5%	EA	1	R02	
014	CF1/8-18-0HMS/J 744051-180	09021	RES FILM 18-OHM 1/8W 5%	EA	1	R03	
015	CF1/8-24-0HMS/J 744051-240	09021	RES FILM 24-OHM 1/8W 5%	EA	2	R05 07	
016	CF1/8-36-0HMS/J 744051-360	09021	RES FILM 36-OHM 1/8W 5%	EA	1	R06	
017	CF1/8-47-0HMS/J 744051-470	09021	RES FILM 47-OHM 1/8W 5%	EA	1	R09	
018	627602-027 627602-027	14482	IC-220 CT MET CAN	EA	1	U01	
019	627602-028 627602-028	14482	IC-230 CT MET CAN	EA	1	U02	
026	659678 659678	14482	SCHEM DIAG	EA	REF		
027	ATC100B* 990018-736	29990	CAP CHIP FACTORY SELECT	EA	1	C13	SEE NOTE 1

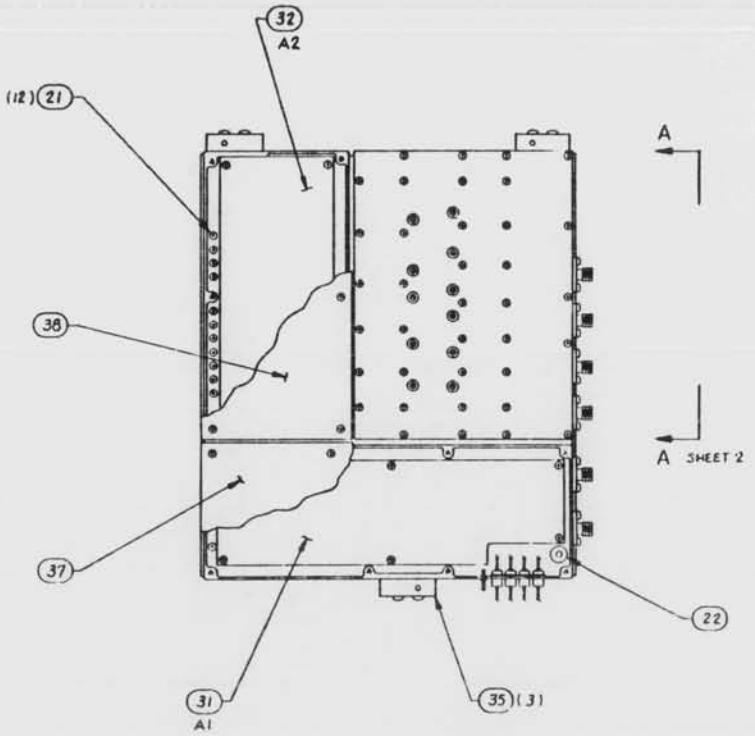
Figure 5-19. 50 to 1050 MHz CCA A3A7 Parts List, Part No. 659702 (Sheet 2 of 3)

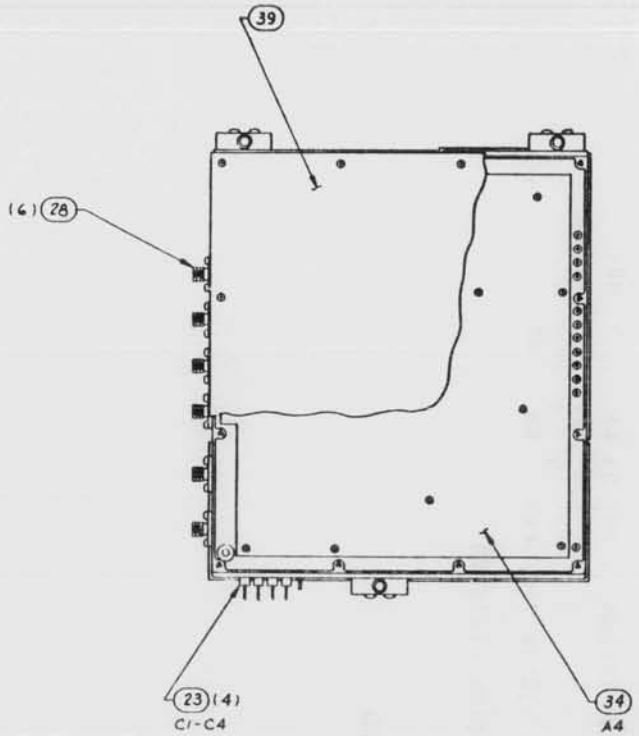
ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
028	CF1/8-10-0HMS/J 744051-100	09021	RES FILM 10-OHM 1/8W 5%	EA	1	R04
029	4S/60T-36L 082337-000	74858	SOLDER SILVER TIN/LEAD	EA	AR	
			EXPLOSION FINISHED			

NOTES: UNLESS OTHERWISE SPECIFIED

1. FACTORY SELECT

Figure 5-19. 50 to 1050 MHz CCA A3A7 Parts List, Part No. 659702 (Sheet 3 of 3)





[3] INSTALL TWO LAYERS OF ITEM 60 ON TOP OF ITEM 17 CUT TO FIT AT ASSEMBLY, 11 PLACES.

2. **REFERENCE DESIGNATIONS ARE FOR REFERENCE ONLY AND MAY OR MAY NOT APPEAR ON PART.**

1. **SOLDER PER MIL-STD-454 REQUIREMENTS**

NOTES: UNLESS OTHERWISE SPECIFIED.

659903/1

[7] SOLDER ITEM 60 BETWEEN ITEMS 19 AND 33, 54 AND 33 FULL WIDTH GROUND PLANE SIDE

[6] ADD 24 GA WHITE WIRE FROM FEED THRUS TO A2E1 THRU A2E11 AS SHOWN.

[5] SOLDER ITEM 59 TO ENDS OF ITEM 24, 11 PLACES.

[4] PLACE SOLDER WASHER ITEM 58 OVER FEED THRU AND SOLDER TO TERMINAL AND GROUND PLANE, 13 PLACES

Figure 5-20. First LO Synthesizer A4 Parts List, Part No. 659903 (Sheet 1 of 5)

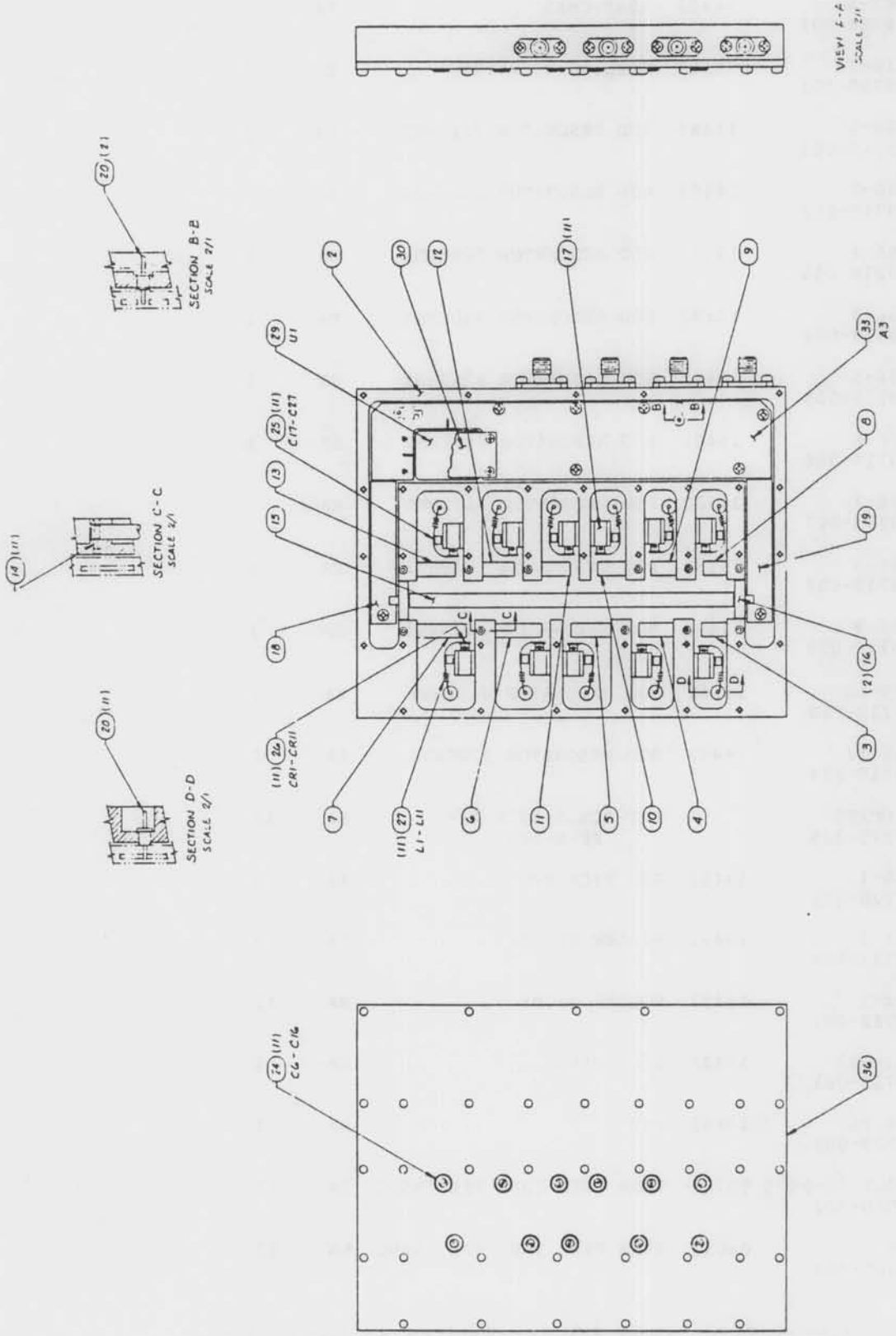


Figure 5-20. First LO Synthesizer A4 Parts List, Part No. 659903 (Sheet 2 of 5)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
001	480907-1 659708-001	14482	ASSY-CHAS	EA	1	
002	580516-1 659718-001	14482	HOUSING - CAVITY	EA	1	
003	281266-1 659719-001	14482	ROD RESONATOR 7400MHZ	EA	1	
004	281266-2 659719-002	14482	ROD RESONATOR 5800MHZ	EA	1	
005	281266-3 659719-003	14482	ROD RESONATOR 5000MHZ	EA	1	
006	281266-4 659719-004	14482	ROD RESONATOR 4400MHZ	EA	1	
007	281266-5 659719-005	14482	ROD RESONATOR 4200MHZ	EA	1	
008	281266-6 659719-006	14482	ROD RESONATOR 7800MHZ	EA	1	
009	281266-7 659719-007	14482	ROD RESONATOR 7600MHZ	EA	1	
010	281266-8 659719-008	14482	ROD RESONATOR 6800MHZ	EA	1	
011	281266-9 659719-009	14482	ROD RESONATOR 6600MHZ	EA	1	
012	281266-10 659719-010	14482	ROD RESONATOR 6000MHZ	EA	1	
013	281266-11 659719-011	14482	ROD RESONATOR 5200MHZ	EA	1	
014	AN565DC2H2 556020-125		SET-SCR 2-56 X 1/8 FF-S-103	EA	11	
015	281270-1 659720-001	14482	ROD PICK UP	EA	1	
016	281271-1 659721-001	14482	PILLOW BLOCK	EA	2	
017	281272-1 659722-001	14482	HOLDER DIODE	EA	11	
018	659723-001 659723-001	14482	SPCR MIXER	EA	1	
019	281246-P1 659728-001	14482	PWB	EA	1	
020	011-1001-00-0479 529060-002	98291	TERM FEED THRU TFL INSUL	EA	13	
021	SFU16Y 529060-003	04013	TERM FEED THRU TFL INSUL	EA	12	

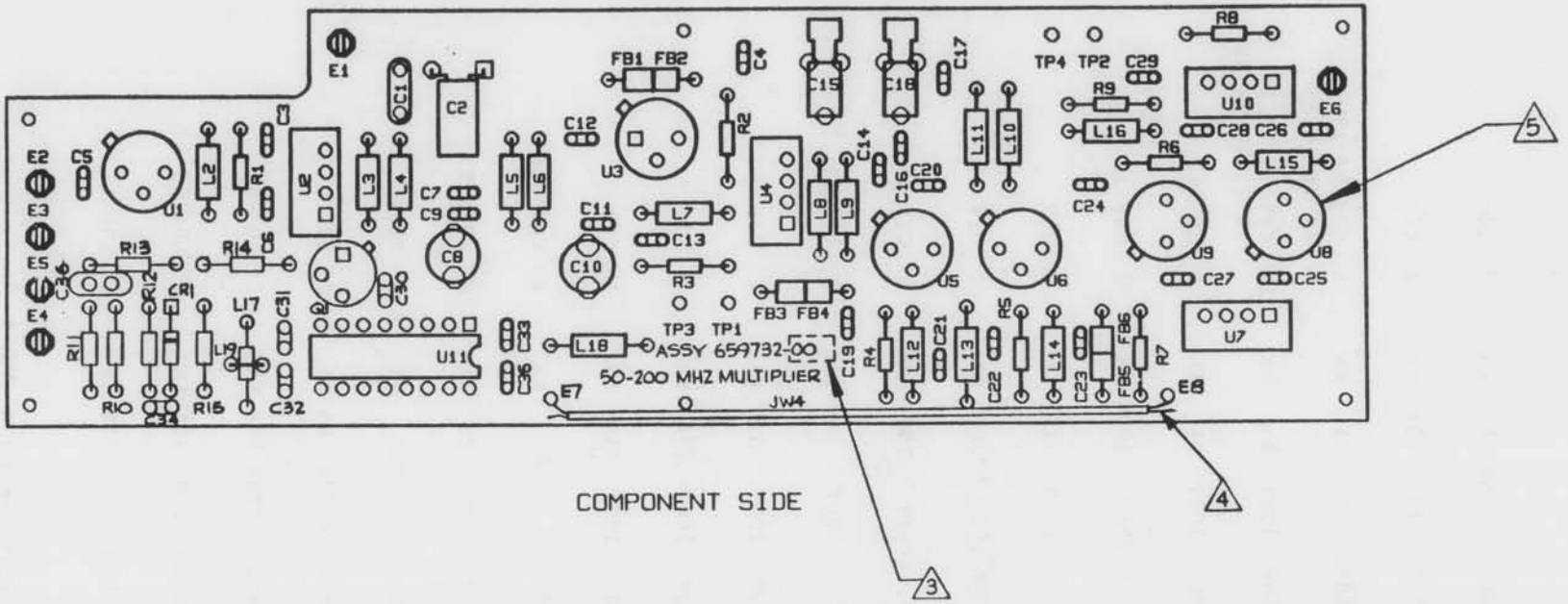
Figure 5-20. First LO Synthesizer A4 Parts List, Part No. 659903 (Sheet 3 of 5)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
022	2185 584100-025		GROMMET	EA	1	
023	2425003W5U0102AA 056340-000	72982	CAP CER F/T 1KPF	EA	4	C01-04
024	6925-5 990018-578	91293	CAP VAR AIR	EA	11	C06-16
025	ATC700B300JP500X 990018-579	29990	CAP CHIP 30PF 500V 5%	EA	11	C17-27
026	DS25062-500 990018-580		DIO	EA	11	CR01-11
027	COIL-TBD COIL-TBD	14482	COIL TO BE DETERMINED	EA	11	L01-11
028	180379-2 659731-002	14482	CONN STR MOD	EA	4	J01-04
029	MD-186 990018-618	21912	MIXER DBL BALANCED 4-8GHZ	EA	1	U01
030	281265-1 659683-001	14482	CLAMP CMPNT	EA	1	
031	381011-1 659732-001	14482	ASSY-CCA 50-200MHZ	EA	1	A01
032	381012-1 659736-001	14482	ASSY-CCA DIVIDER	EA	1	A02
033	381013-1 659740-001	14482	ASSY-CCA MIXER	EA	1	A03
034	480897-1 659744-001	14482	ASSY-CCA DISTRIBUTION	EA	1	A04
035	660061-001 660061-001	14482	MTG BLOCK	EA	3	
036	480882-1 659749-001	14482	COVER - CAVITY	EA	1	
037	480895-1 659750-001	14482	COVER - MULTIPLIER	EA	1	
038	381085-1 659752-001	14482	COVER - DIVIDER	EA	1	
039	480904-1 659754-001	14482	COVER - DISTRIBUTION	EA	1	

Figure 5-20. First LO Synthesizer A4 Parts List,
Part No. 659903 (Sheet 4 of 5)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
052	580536 659904	14482	SCHEM DIAG	EA	REF	
053	660179-004 660179-004	14482	ASSY-CABLE	EA	1	
054	659726-001 659726-001	14482	PWB	EA	1	
			EXPLOSION FINISHED			

Figure 5-20. First LO Synthesizer A4 Parts List, Part No. 659903 (Sheet 5 of 5)



1. PARTS LIST REFER PL 659732.
2. MAXIMUM COMPONENT HEIGHT ABOVE BOARD 0.25.
3. MARK APPROPRIATE DASH NUMBER AFTER ASSEMBLY.
4. SOLDER GND WIRE TO CLAD GND PLANE TWO PLACES.
5. MOUNT U1, 3, 5, 6, 8, 9 FLUSH TO PWB. SOLDER AROUND EDGES.

NOTES: UNLESS OTHERWISE SPECIFIED.

659732A

Figure 5-21. 50 to 200 MHz Multiplier CCA A4A1 Parts List, Part No. 659732 (Sheet 1 of 4)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
001	659733-001 659733-001	14482	PWB	EA	1	
002	660073-104 660073-104	14482	CAP CER .1UF 50V 20%	EA	1	C01
003	196D226X9010JE3 990018-334	56289	CAP TANT 22UF 10V 20%	EA	1	C02
004	150-100-NP0-102G 759163-100	51642	CAP CER 1000PF 100V 2%	EA	8	C03 04 19 22 24 29 30 35
005	150-100-NP0-471G 759162-470	51642	CAP CER 470PF 100V 2%	EA	11	C05 06 12 13 20 23 25-28 34
006	100-100-NP0-120G 759161-120	51642	CAP CER 12PF 100V 2%	EA	2	C07 11
007	518-000A5-25 990018-360	59660	CAP VAR CER 5-25PF 100V	EA	2	C08 10
008	100-100-NP0-209B 759160-200	51642	CAP CER 2PF 100V .1PF	EA	1	C09
009	8111-100-C0G0-* 990018-738	59660	CAP DISC 20PF 100V *200J	EA	2	C14 17
010	5701 990018-414	91293	CAP VAR AIR .6-6PF 250V	EA	2	C15 18
011	100-100-NP0-109B 759160-100	51642	CAP CER 1PF 100V .1PF	EA	2	C16 31
012	100-100-NP0-439B 759160-430	51642	CAP CER 4.3PF 100V .1PF	EA	1	C21
013	100-100-NP0-829C 759160-820	51642	CAP CER 8.2PF 100V .25PF	EA	1	C32
014	200-100-NP0-101G 759162-100	51642	CAP CER 100PF 100V 2%	EA	1	C33
016	56-590-65-4A 792020-014	02114	FERRITE BEAD	EA	6	FB01-06
017	22AWG-QQW343 442222-000		WIRE BUS SOLID TINNED CU QQ-W-343	FT	A/R	JW01-03
018	CXN1214 450010-008	17217	CABLE COAX MINI 50-OHM	FT	A/R	JW04
020	1025-28 760041-220	99800	COIL FIXED MOLD 2.2UH 10%	EA	2	L02 07
021	1025-08 760040-330	99800	COIL FIXED MOLD .33UH 10%	EA	2	L03 06
022	1025-94 760040-100	99800	COIL FIXED MOLD .1UH 10%	EA	3	L04 05 17
023	L10-0R169 760040-169	7W259	COIL FXD .169UH 1%	EA	2	L08 11

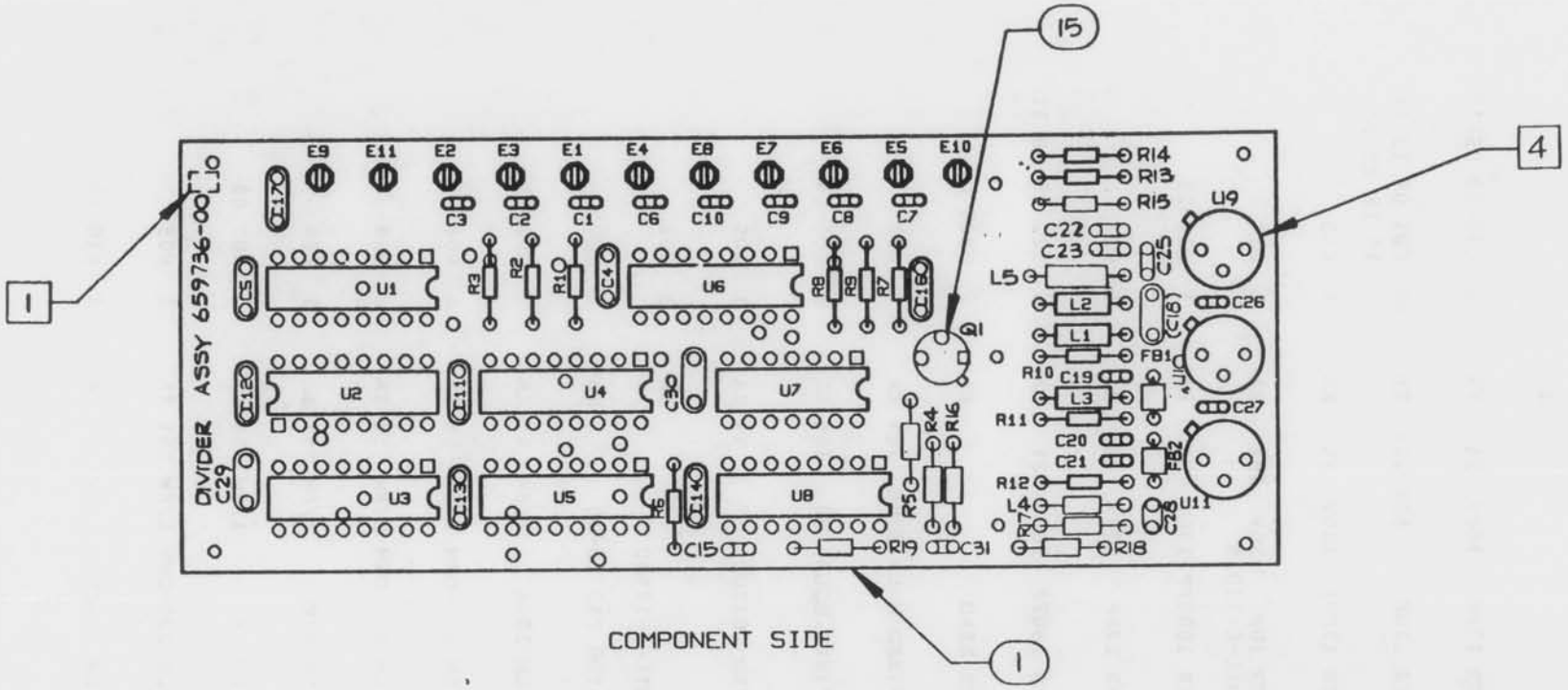
Figure 5-21. 50 to 200 MHz Multiplier CCA A4A1 Parts List, Part No. 659732 (Sheet 2 of 4)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
024	L10-0R040 760040-040	7W259	COIL FXD .040UH	1% EA	2	L09 10
025	1025-20 760041-100	99800	COIL FIXED MOLD 1UH	10% EA	4	L12 14-16
026	L10-0R154 760040-154	7W259	COIL FXD .154UH	1% EA	1	L13
027	L10-0R039 760040-039	7W259	COIL FXD .039UH	1% EA	1	L18
028	660058-001 660058-001	14482	INDUCTOR	EA	1	L19
029	JAN2N2907 780000-001C		XSTR MIL-S-19500	EA	1	Q01
030	7717-16DAP 702023-012	13103	INSULATOR PAD	EA	1	XQ01
031	CF1/8-22-0HMS/J 744051-220	09021	RES FILM 22-OHM 1/8W 5%	EA	1	R01
032	CF1/8-39-0HMS/J 744051-390	09021	RES FILM 39-OHM 1/8W 5%	EA	3	R02 11 12
033	CF1/8-470-0HMS/J 744052-470	09021	RES FILM 470-OHM 1/8W 5%	EA	2	R03 08
034	CF1/8-120-0HMS/J 744052-120	09021	RES FILM 120-OHM 1/8W 5%	EA	1	R04
035	CF1/8-47-0HMS/J 744051-470	09021	RES FILM 47-OHM 1/8W 5%	EA	1	R05
036	CF1/8-15-0HMS/J 744051-150	09021	RES FILM 15-OHM 1/8W 5%	EA	2	R06 09
037	CF1/8-200-0HMS/J 744052-200	09021	RES FILM 200-OHM 1/8W 5%	EA	1	R07
038	CF1/8-150-0HMS/J 744052-150	09021	RES FILM 150-OHM 1/8W 5%	EA	1	R10
039	CF1/8-2.7K/J 744053-270	09021	RES FILM 2.7K 1/8W 5%	EA	1	R13
040	CF1/8-47K/J 744054-470	09021	RES FILM 47K 1/8W 5%	EA	1	R14
041	CF1/8-10K/J 744054-100	09021	RES FILM 10K 1/8W 5%	EA	1	R15
042	627602-027 627602-027	14482	IC-220 CT MET CAN	EA	2	U01 06
043	SK-2 990018-608	15542	FREQUENCY DOUBLER	EA	2	U02 04

Figure 5-21. 50 to 200 MHz Multiplier CCA A4A1 Parts List, Part No. 659732 (Sheet 3 of 4)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
044	GPD321 990018-629	24539	AMPL RF	EA	1	U03
045	627601-034 627601-034	14482	IC-110 MT MET CAN	EA	1	U05
046	TSC-2-1 990018-624	15542	PWR SPLTR 1-400MHZ 2WAY	EA	2	U07 10
047	627602-028 627602-028	14482	IC-230 CT MET CAN	EA	2	U08 09
048	627608-360 627608-360	14482	IC-8740 CT PLSTC DIP 4A	EA	1	U11
049	5082-3188 990018-292	28480	DIO PIN VHF/UHF 1PF	EA	1	CR01
050	659858 659858	14482	SCHEM DIAG	EA	REF	
051	CK06BX105K 070716-000		CAP CER 1UF 50V 10% MIL-C-11015 EXPLOSION FINISHED	EA	1	C36

Figure 5-21. 50 to 200 MHz Multiplier CCA A4A1 Parts List, Part No. 659732 (Sheet 4 of 4)



[4] MOUNT U9-U11 FLUSH TO BOARD. SOLDER AROUND EDGES.

3. PARTS LIST REFER PL 659736.

2. MAXIMUM COMPONENT HEIGHT ABOVE BOARD 0.250.

[1] MARK APPROPRIATE DASH NUMBER AFTER ASSEMBLY PER MIL-STD-130 USING 0.12 HIGH CHARACTERS WITH WHITE INK COLOR NO. 17875 PER FED-STD-595.

NOTES: UNLESS OTHERWISE SPECIFIED.

659736A

Figure 5-22. Divider CCA A4A2 Parts List, Part No. 659736 (Sheet 1 of 3)

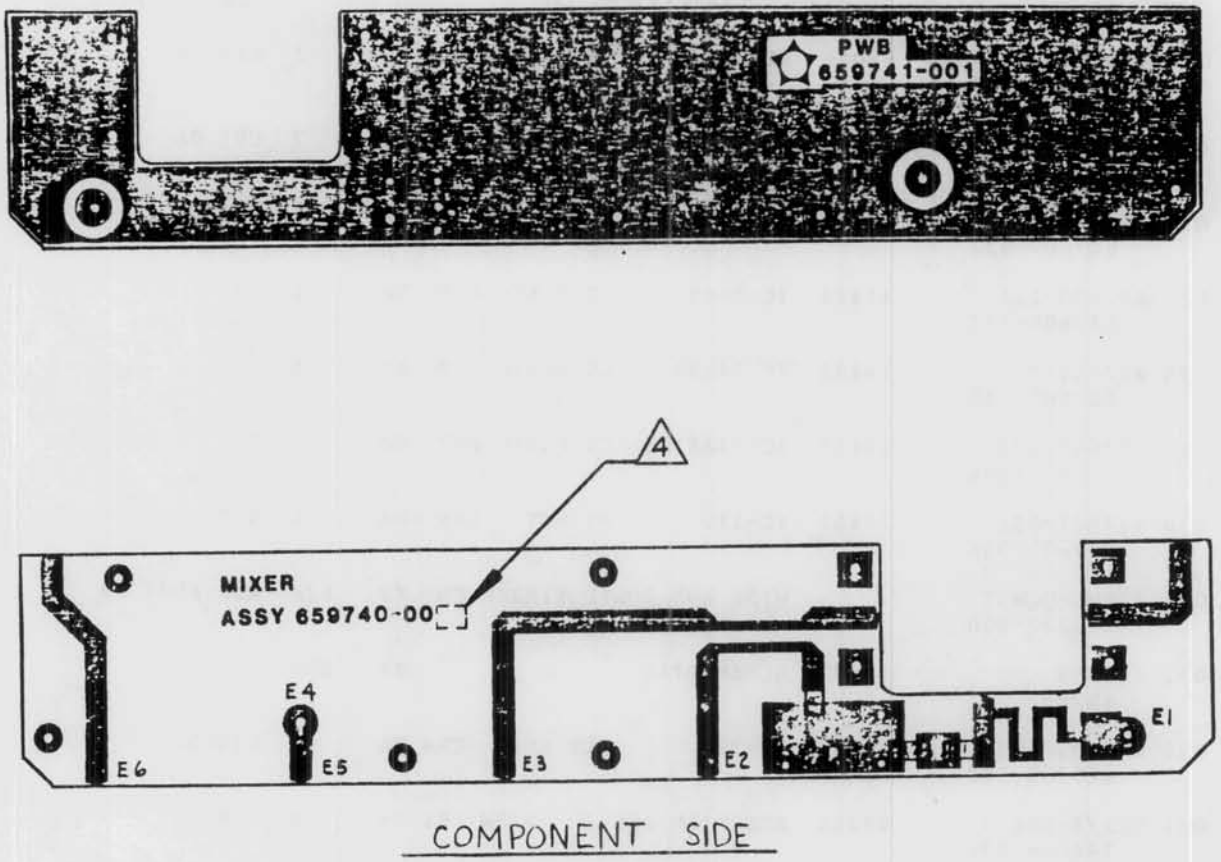
ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
001	659737-001 659737-001	14482	PWB	EA	1	
002	150-100-NP0-470G 759161-470	51642	CAP CER 47PF 100V 2%	EA	8	C01-03 06-10
003	660073-104 660073-104	14482	CAP CER .1UF 50V 20%	EA	10	C04 05 11-14 16 18 29 30
004	150-100-NP0-471G 759162-470	51642	CAP CER 470PF 100V 2%	EA	1	C15
005	CK06BX105K 070716-000		CAP CER 1UF 50V 10% MIL-C-11015	EA	1	C17
006	150-100-NP0-102G 759163-100	51642	CAP CER 1000PF 100V 2%	EA	3	C19-21
008	100-100-NP0-220G 759161-220	51642	CAP CER 22PF 100V 2%	EA	1	C23
009	150-100-NP0-181G 759162-180	51642	CAP CER 180PF 100V 2%	EA	6	C22 25-28 31
010	56-590-65-4A 792020-014	02114	FERRITE BEAD	EA	2	FB01 02
011	1025-56 990018-403	99800	COIL FIXED MOLD 33UH 10%	EA	1	L01
012	1025-20 760041-100	99800	COIL FIXED MOLD 1UH 10%	EA	3	L02-04
013	L10-0R047 990018-404	7W259	COIL FXD .047UH 1%	EA	1	L05
014	JAN2N2907 780000-001C		XSTR MIL-S-19500	EA	1	Q01
015	10109DAP 702023-003	07047	INSULATOR PAD TO-18	EA	1	XQ01
016	CF1/8-100K/J 744055-100	09021	RES FILM 100K 1/8W 5%	EA	3	R01-03
017	CF1/8-270-0HMS/J 744052-270	09021	RES FILM 270-OHM 1/8W 5%	EA	1	R04
018	CF1/8-470-0HMS/J 744052-470	09021	RES FILM 470-OHM 1/8W 5%	EA	1	R05
019	CF1/8-47K/J 744054-470	09021	RES FILM 47K 1/8W 5%	EA	1	R06
020	CF1/8-1K/J 744053-100	09021	RES FILM 1K 1/8W 5%	EA	2	R07 08
021	CF1/8-220-0HMS/J 744052-220	09021	RES FILM 220-OHM 1/8W 5%	EA	1	R09
022	CF1/8-91-0HMS/J 744051-910	09021	RES FILM 91-OHM 1/8W 5%	EA	3	R10-12

Figure 5-22. Divider CCA A4A2 Parts List, Part No. 659736 (Sheet 2 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
023	CF1/8-39-OHMS/J 744051-390	09021	RES FILM 39-OHM 1/8W 5%	EA	2	R13 18
025	627604-087 627604-087	14482	IC-4094 CT PLSTC DIP	EA	2	U01 06
026	627607-432 627607-432	14482	IC-74AS161 CT PLSTC DIP	EA	3	U02 04 05
027	627608-132 627608-132	14482	IC-8685 CT PLSTC DIP	EA	1	U08
028	627607-115 627607-115	14482	IC-74AS10 CT PLSTC DIP	EA	1	U07
029	627607-404 627607-404	14482	IC-74AS109 CT PLSTC DIP	EA	1	U03
030	627601-034 627601-034	14482	IC-110 MT MET CAN	EA	1	U09
031	22AWG-QQW343 442222-000		WIRE BUS SOLID TINNED CU QQ-W-343	FT	A/R	REF FB01 02
032	659858 659858	14482	SCHEM DIAG	EA	REF	
033	627603-108 627603-108	14482	IC-320 CT MET CAN	EA	2	U10 11
034	CF1/8-10K/J 744054-100	09021	RES FILM 10K 1/8W 5%	EA	1	R19
035	CF1/8-150-OHMS/J 744052-150	09021	RES FILM 150-OHM 1/8W 5%	EA	4	R14-17

EXPLOSION FINISHED

Figure 5-22. Divider CCA A4A2 Parts List, Part No. 659736 (Sheet 3 of 3)



NOTES:

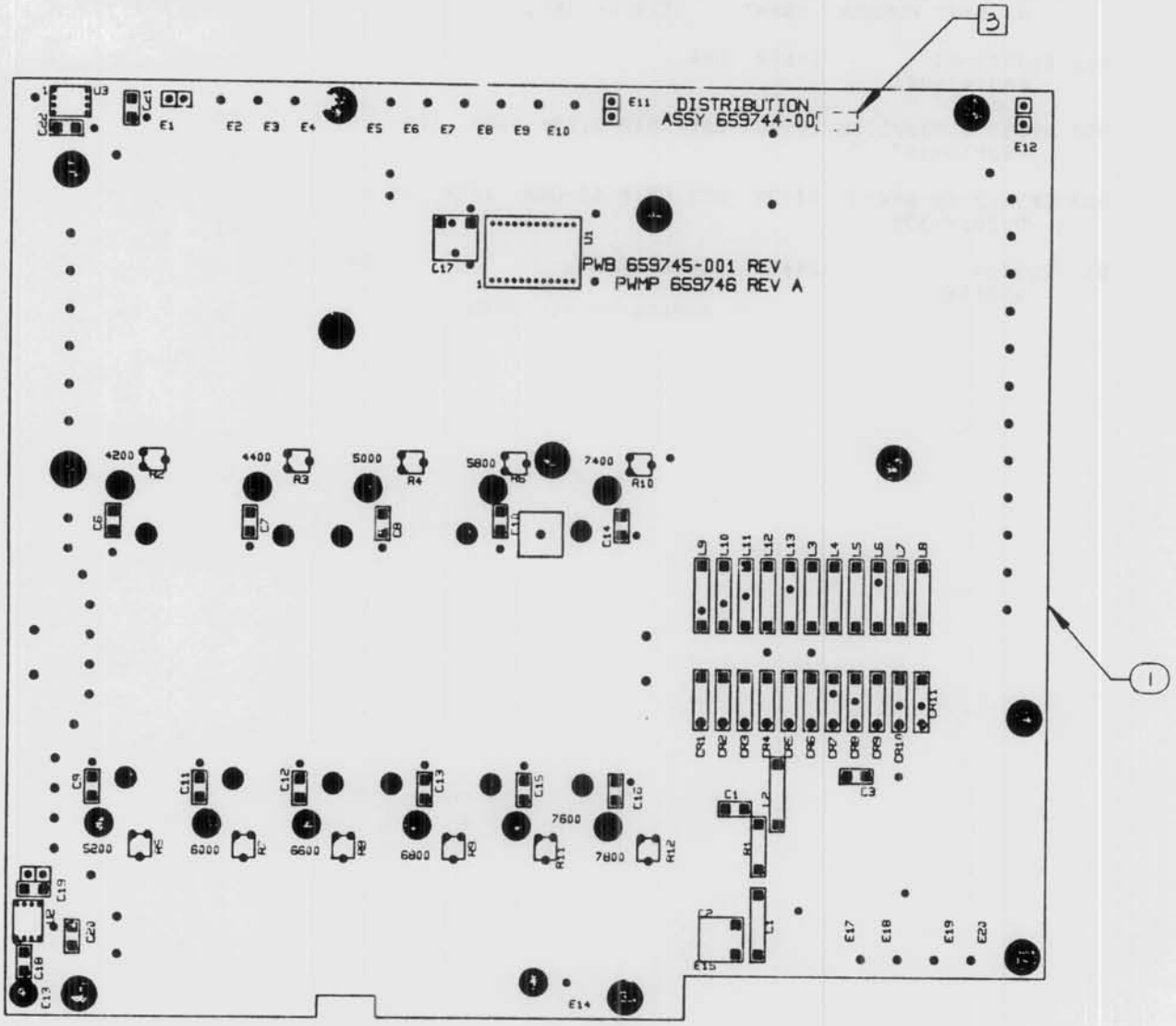
1. PARTS LIST REFER PL 659740.
2. MAXIMUM COMPONENT HEIGHT ABOVE BOARD 0.125.
3. DARK AREA INDICATES CLAD.
4. MARK APPROPRIATE DASH NUMBER AFTER ASSEMBLY.

659740

Figure 5-23. Mixer CCA A4A3 Parts List, Part No. 659740 (Sheet 1 of 2)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
001	659741-001 659741-001	14482	PWB	EA	1	
002	ATC100B2R2BP500X 990018-397	29990	CAP CHIP 2.2PF 500V .1PF	EA	1	C01
003	CR15T2-50-0HM-2% 990018-398	24602	RES CHIP 50-OHM 1/4W 2%	EA	2	R01 02
013	659858 659858	14482	SCHEM DIAG	EA	REF	
			EXPLOSION FINISHED			

Figure 5-23. Mixer CCA A4A3 Parts List, Part No. 659740 (Sheet 2 of 2)



5. MAXIMUM COMPONENT HEIGHT ABOVE BOARD 0.14.

4. ALL COMPONENTS ARE TO BE SURFACE-MOUNTED.

[3] MARK EACH DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH BLACK INK COLOR NO. 17038 PER FED-STD-595.

2. OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

NOTES: UNLESS OTHERWISE SPECIFIED.

659744A

Figure 5-24. Distribution CCA A4A4 Parts List, Part No. 659744 (Sheet 1 of 2)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS Rev. A
001	659745-001 659745-001	14482	PWB	EA	1	
002	C1210E471K1GAH 756152-470	31433	CAP CHIP 470PF 100V 10%	EA	1	C01
003	660073-104 660073-104	14482	CAP CER .1UF 50V 20%	EA	2	C02 17
004	ATC100B180JP500X 990018-391	29990	CAP CHIP 18PF 500V 5%	EA	11	C06-16
006	5082-3188 990018-292	28480	DIO PIN VHF/UHF 1PF	EA	11	CR01-11
007	1025-94 760040-100	99800	COIL FIXED MOLD .1UH 10%	EA	1	L01
008	1025-20 760041-100	99800	COIL FIXED MOLD 1UH 10%	EA	11	L03-13
009	L10-0R068 990018-254	7W259	INDUCTOR .068UH 2000MA 1%	EA	1	L02
010	CF1/8-330-0HMS/J 744052-330	09021	RES FILM 330-OHM 1/8W 5%	EA	1	R01
011	3304W-1-202 990018-891	32997	RES VAR 2K	EA	11	R02-12
012	627607-344 627607-344	14482	IC-74HC154 CT PLSTC FP	EA	1	U01
026	659858 659858	14482	SCHEM DIAG	EA	REF	
027	CK05BX102K 750203-100		CAP CER .001UF 200V 10% MIL-C-11015	EA	2	C03 21
028	ATC100B102KP50 990018-783	29990	CAP CHIP 1000PF 50V 10%	EA	3	C19 20 22
029	627605-419 627605-419	14482	IC-5205D IT PLSTC DIP	EA	2	U02 03
030	CK05BX181K 750202-180		CAP CER 180PF 200V 10% MIL-C-11015 EXPLOSION FINISHED	EA	1	C18

Figure 5-24. Distribution CCA A4A4 Parts List, Part No. 659744
(Sheet 2 of 2)

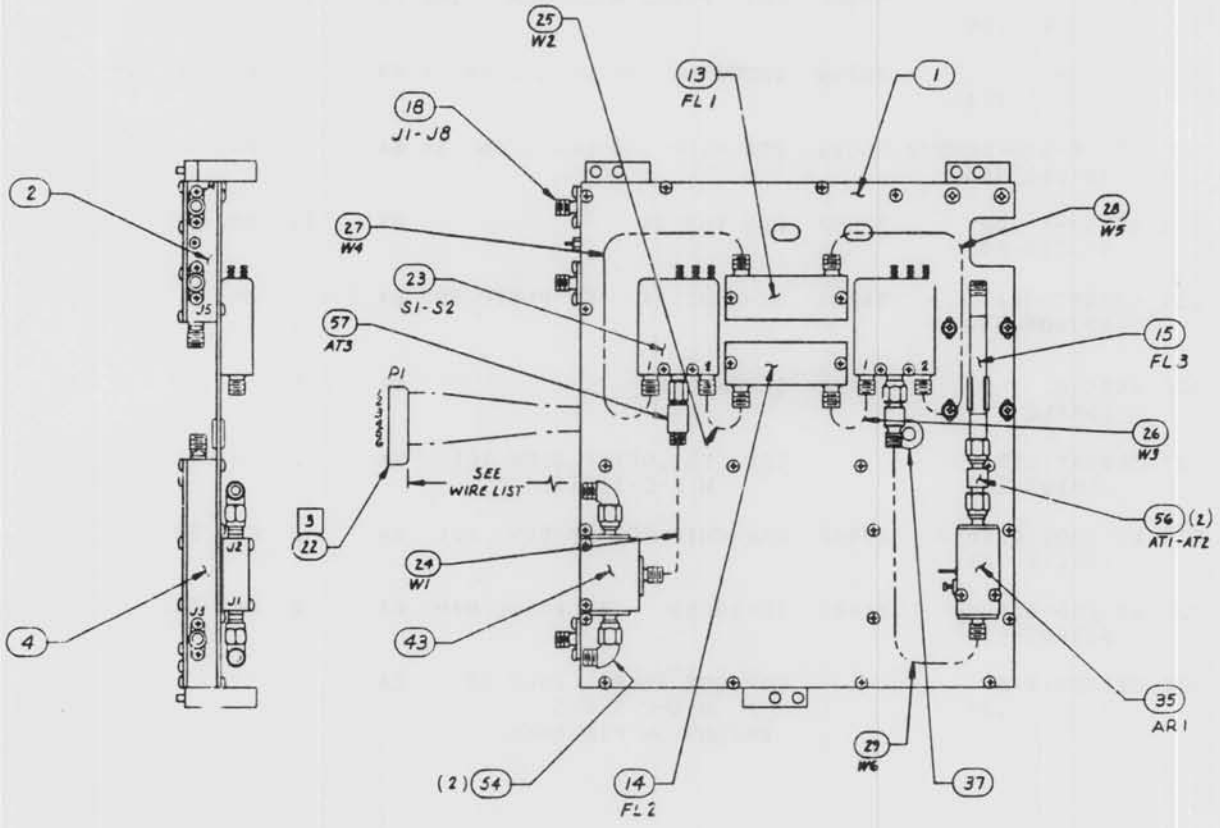
WIRE LIST

ITEM NO	FROM	TO	LENGTH (INCHES)	REMARKS
48	P1-5	A1-E2	*	IF SELECT
49	P1-7	A1-E3	*	+ 5V
50	P1-6	A1-E1	*	+ 20V
51	P1-4	A1-E9	*	GND
52	P1-2	FL8	*	+ 15V
	FL8	FL6	3.0	
	FL9	AR1	3.5	
	FL9	FL5	3.0	
	FL5	FL6	5.5	
45	FL9	A5-E1	2.5	
53	P1-1	FL7	*	+ 8V

WIRE LIST

ITEM NO	FROM	TO	LENGTH (INCHES)	REMARKS
50	A1-E4	S2-COM	*	+ 20V
50	S2-COM	S1-COM	*	+ 20V
48	A1-E5	S1-2	*	LOGIC
	A1-E6	S1-1	*	
	A1-E7	S2-1	*	
	A1-E8	S2-2	*	
39	FL5	A3-E1	*	+ 15V
	FL6	A4-E1	*	+ 15V
	FL7	A6-E1	*	+ 8V
	FL8	A6-E2	*	+ 15V

* LENGTH OF CABLE IS 7.50 ± .25



3 PIN 3 EMPTY ON ITEM 22.

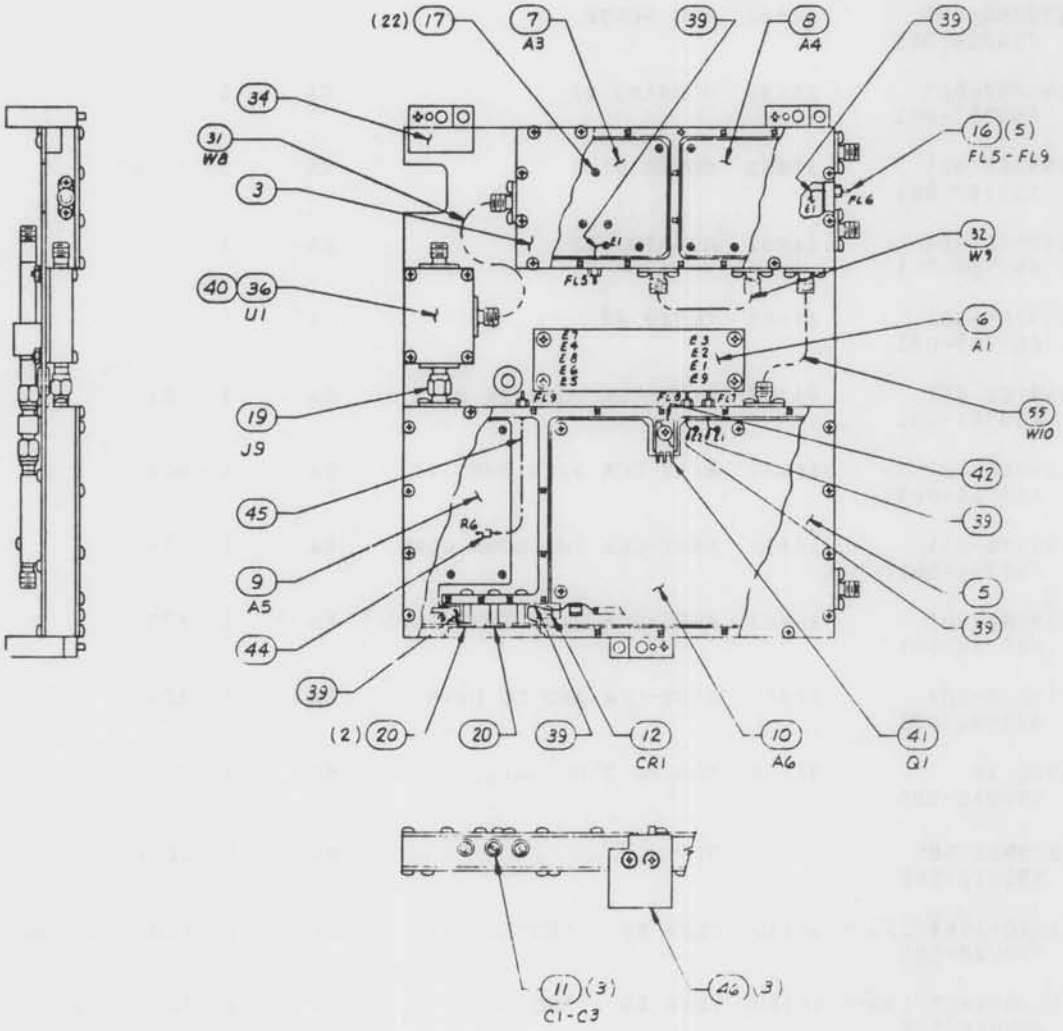
2. REFERENCE DESIGNATIONS ARE FOR REFERENCE ONLY AND MAY OR MAY NOT APPEAR ON PART.

1. SOLDER PER MIL-STD-454 REQUIREMENTS.

NOTES: UNLESS OTHERWISE SPECIFIED.

659905B/1

Figure 5-25. IF Assembly A6 Parts List, Part No. 659905 (Sheet 1 of 5)



659905B/2

Figure 5-25. IF Assembly A6 Parts List, Part No. 659905 (Sheet 2 of 5)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS Rev. A	
001	659756-001 659756-001	14482	MTG PLATE	EA	1		
002	659757-001 659757-001	14482	HOUSING #1	EA	1		
003	659760-001 659760-001	14482	COVER #1	EA	1		
004	659758-001 659758-001	14482	HOUSING #2	EA	1		
005	659759-001 659759-001	14482	COVER #2	EA	1		
006	659761-001 659761-001	14482	ASSY-CCA COAX SW DRVR	EA	1	A01	
007	659765-001 659765-001	14482	ASSY-CCA 1222.5MHZ IF	EA	1	A03	
008	659774-001 659774-001	14482	ASSY-CCA 2ND DOWN CONV	EA	1	A04	
009	659786-001 659786-001	14482	ASSY-CCA 3187.5MHZ AMPL	EA	1	A05	
010	659802-001 659802-001	14482	ASSY-CCA 2ND LO DRVR	EA	1	A06	
011	6926-14 990018-585	91293	TUNING SLUG	EA	3	C01-03	
012	DS25062-500 990018-580		DIO	EA	1	CR01	
013	4IB10-1964/150-* 990018-587	50140	FLTR BP *EO/EO	EA	1	FL01	SEE NOTE 1
014	4IB10-4408/150-* 990018-588	50140	FLTR BP *EO/EO	EA	1	FL02	SEE NOTE 2
015	5L250-5000-0P/0 990018-789	50140	FLTR LP	EA	1	FL03	
016	51-729-305 990018-586	33095	FLTR F/T 5500PF 100V	EA	5	FL05-09	
017	MS21318-9 553000-250		SCR PAN HD 0-80X1/4 FF-S-107	EA	22		
018	659731-001 659731-001	14482	CONN STR MOD	EA	8	J01-08	
019	659874-001 659874-001	14482	CONN MOD	EA	1	J09	
020	659811-002 659811-002	14482	FLTR 3150MHZ	EA	2		
021	659811-001 659811-001	14482	FLTR 3150MHZ	EA	1		

Figure 5-25. IF Assembly A6 Parts List, Part No. 659905 (Sheet 3 of 5)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
022	660179-006 660179-006	14482	ASSY-CABLE	EA	1	P01
023	659558-001 659558-001	14482	SW COAX SPDT MOD	EA	2	S01 02
024	659739-001 659739-001	14482	ASSY-CABLE COAX SR	EA	1	W01
025	659739-002 659739-002	14482	ASSY-CABLE COAX SR	EA	1	W02
026	659739-003 659739-003	14482	ASSY-CABLE COAX SR	EA	1	W03
027	659739-004 659739-004	14482	ASSY-CABLE COAX SR	EA	1	W04
028	659739-005 659739-005	14482	ASSY-CABLE COAX SR	EA	1	W05
029	659739-006 659739-006	14482	ASSY-CABLE COAX SR	EA	1	W06
030	659739-007 659739-007	14482	ASSY-CABLE COAX SR	EA	1	W07
031	659739-008 659739-008	14482	ASSY-CABLE COAX SR	EA	1	W08
032	659739-009 659739-009	14482	ASSY-CABLE COAX SR	EA	1	W09
034	660131-001 660131-001	14482	BRKT	EA	1	
035	AFM/045-4010-36 990018-774		AMPL 1.8-4.5GHZ	EA	1	AR01
036	MDC-162 990018-773	21912	MIXER	EA	1	U01
037	2172 584100-026	83330	GROMMET 3/16IDX5/16OD	EA	1	
038	659906 659906	14482	SCHEM DIAG	EA	REF	
039	22AWG-QQW343* 22AWG-QQW343*		WIRE BUS O-OHM	FT	AR	
040	659723-001 659723-001	14482	SPCR MIXER	EA	1	
041	MJE800 990018-377	04713	XSTR	EA	1	Q01
042	60-11-5791-1674 702028-001	18565	INSULATOR PAD	EA	1	
043	WJM83C 990006-354	14482	MIXER	EA	1	

Figure 5-25. IF Assembly A6 Parts List, Part No. 659905 (Sheet 4 of 5)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS	
044	56-590-65-4A 792020-014	02114	FERRITE BEAD	EA	AR		
045	24AWG-S-TY-E-9 445240-009		WIRE TFL SHLDED WHT MIL-W-16878	FT	AR		
046	659879-001 659879-001	14482	MTG BLOCK	EA	3		
048	24AWG-TY-E-9 430240-009		WIRE TFL WHT MILW16878 MIL-W-16878	FT	AR		
049	24AWG-TY-E-2 430240-002		WIRE TFL RED MILW16878 MIL-W-16878	FT	AR		
050	24AWG-TY-E-5 430240-005		WIRE TFL GRN MILW16878 MIL-W-16878	FT	AR		
051	22AWG-TY-E-0 430220-000		WIRE TFL BLK MILW16878 MIL-W-16878	FT	AR		
052	22AWG-TY-E-4 430220-004		WIRE TFL YEL MILW16878 MIL-W-16878	FT	AR		
053	22AWG-TY-E-3 430220-003		WIRE TFL ORN MILW16878 MIL-W-16878	FT	AR		
054	CDI-5490 090893-000	30990	ADPTR 90 DEG ELBOW	EA	2		
055	659739-010 659739-010	14482	ASSY-CABLE COAX SR	EA	1	W10	
056	632675-021 632675-021	14482	ATTEN PAD 1DB DC-18GHZ	EA	2	AT01 02	
057	632675-022 632675-022	14482	ATTEN PAD 2DB DC-18GHZ	EA	1	AT03	
058	632675-020 632675-020	14482	ATTEN PAD 0DB DC-18GHZ	EA	1	AT04	SEE NOTE 3

EXPLOSION FINISHED

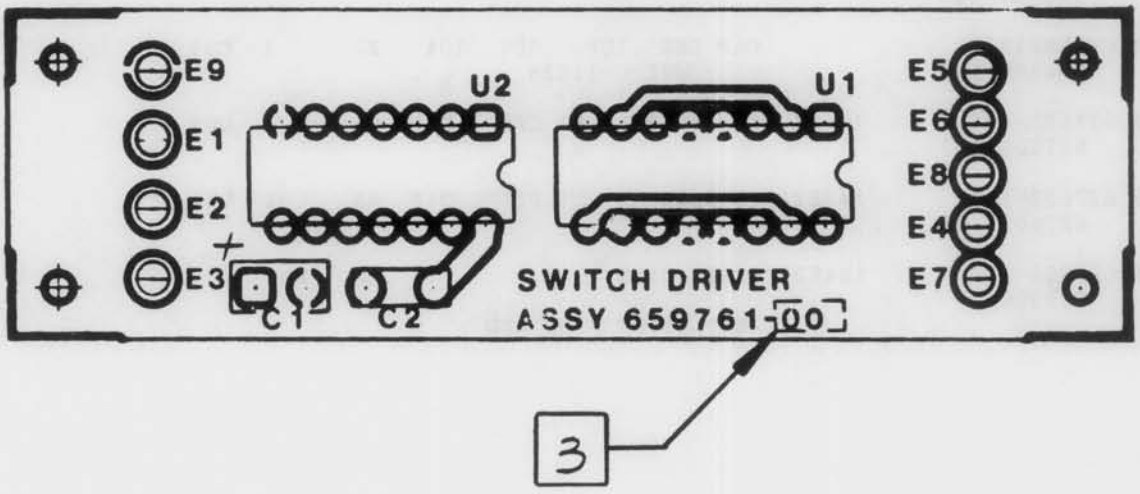
NOTES: UNLESS OTHERWISE SPECIFIED

1: ALTERNATE PART NUMBER MBP-1964-150-4-R (MFG RLC).

2: ALTERNATE PART NUMBER MBP-4408-150-4-R (MFG RLC).

3: FACTORY SELECT NOMINAL VALUE SHOWN.

Figure 5-25. IF Assembly A6 Parts List, Part No. 659905 (Sheet 5 of 5)



[3] MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH WHITE INK COLOR NO. 17875 PER FED-STD-595.

2 OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

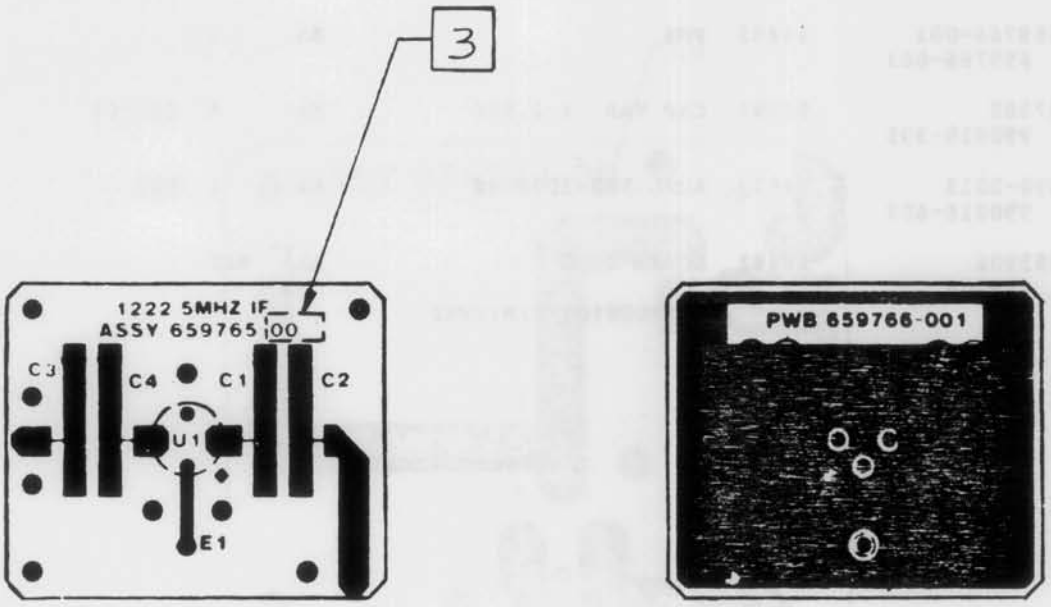
NOTES: UNLESS OTHERWISE SPECIFIED.

659761

Figure 5-26. Switch Driver CCA A6A1 Parts List, Part No. 659761 (Sheet 1 of 2)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS Rev. A
001	659762-001 659762-001	14482	PWB	EA	1	
002	MMM-020-475R-20 990017-943	14674	CAP TANT 4.7UF 20V 20%	EA	1	C01
003	CK05BX104K 750105-100		CAP CER .1UF 50V 10% MIL-C-11015	EA	1	C02
004	627605-493 627605-493	14482	IC-54LS04 MT CER DIP	EA	1	U02
005	627603-104 627603-104	14482	IC-3658 CT PLSTC DIP	EA	1	U01
006	659906 659906	14482	SCHEM DIAG	EA	REF	
			EXPLOSION FINISHED			

Figure 5-26. Switch Driver CCA A6A1 Parts List, Part No. 659761
(Sheet 2 of 2)



[3] MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH BLACK INK COLOR NO. 17038 PER FED-STD-595.

2 OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

NOTES: UNLESS OTHERWISE SPECIFIED.

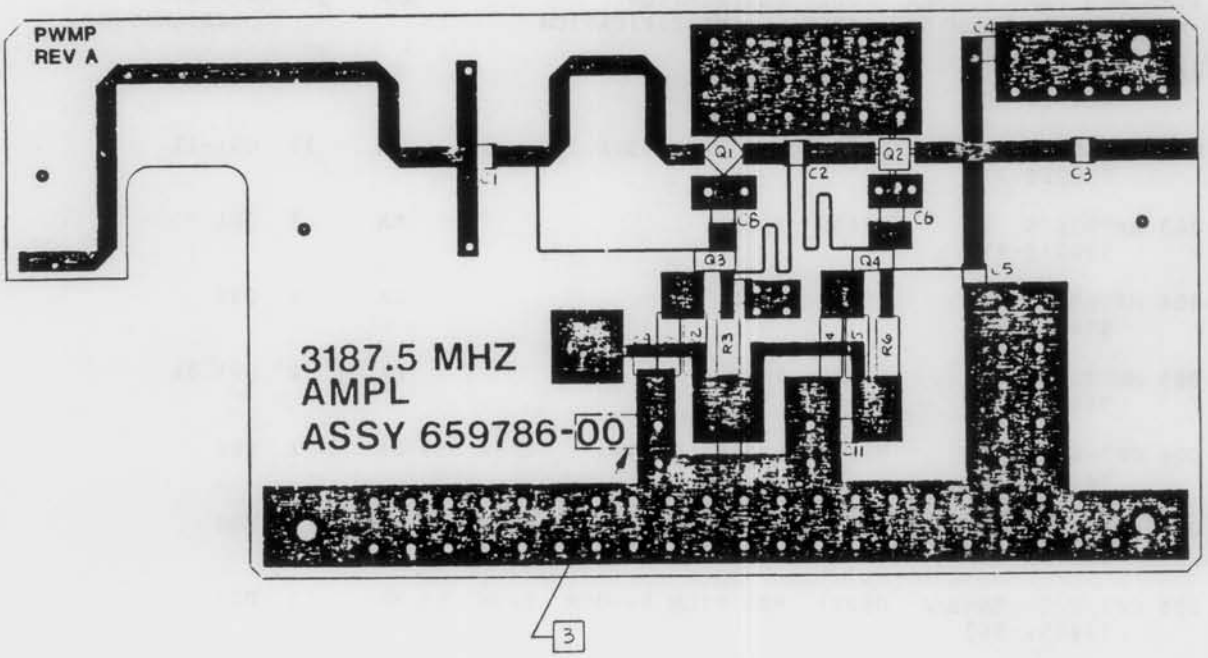
659765

Figure 5-27. 1222.5 MHz IF CCA A6A3 Parts List, Part No. 659765 (Sheet 1 of 2)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS Rev. A
001	659775-001 659775-001	14482	PWB	EA	1	
002	WJM2B 990006-315	14482	MIXER DOUBLE BALANCED	EA	1	U01
003	WJA87-1 990009-332	14482	AMPL	EA	1	U02
004	CF1/8-47-OHMS/J 744051-470	09021	RES FILM 47-OHM 1/8W 5%	EA	1	R01
005	CF1/8-330-OHMS/J 744052-330	09021	RES FILM 330-OHM 1/8W 5%	EA	2	R02 03
006	659906 659906	14482	SCHEM DIAG	EA	REF	

EXPLOSION FINISHED

Figure 5-28. Second Down Converter CCA A6A4 Parts List, Part No. 659774 (Sheet 2 of 2)



3 MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH BLACK INK COLOR NO. 17038 PER FED-STD-595.

2 OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

NOTES: UNLESS OTHERWISE SPECIFIED.

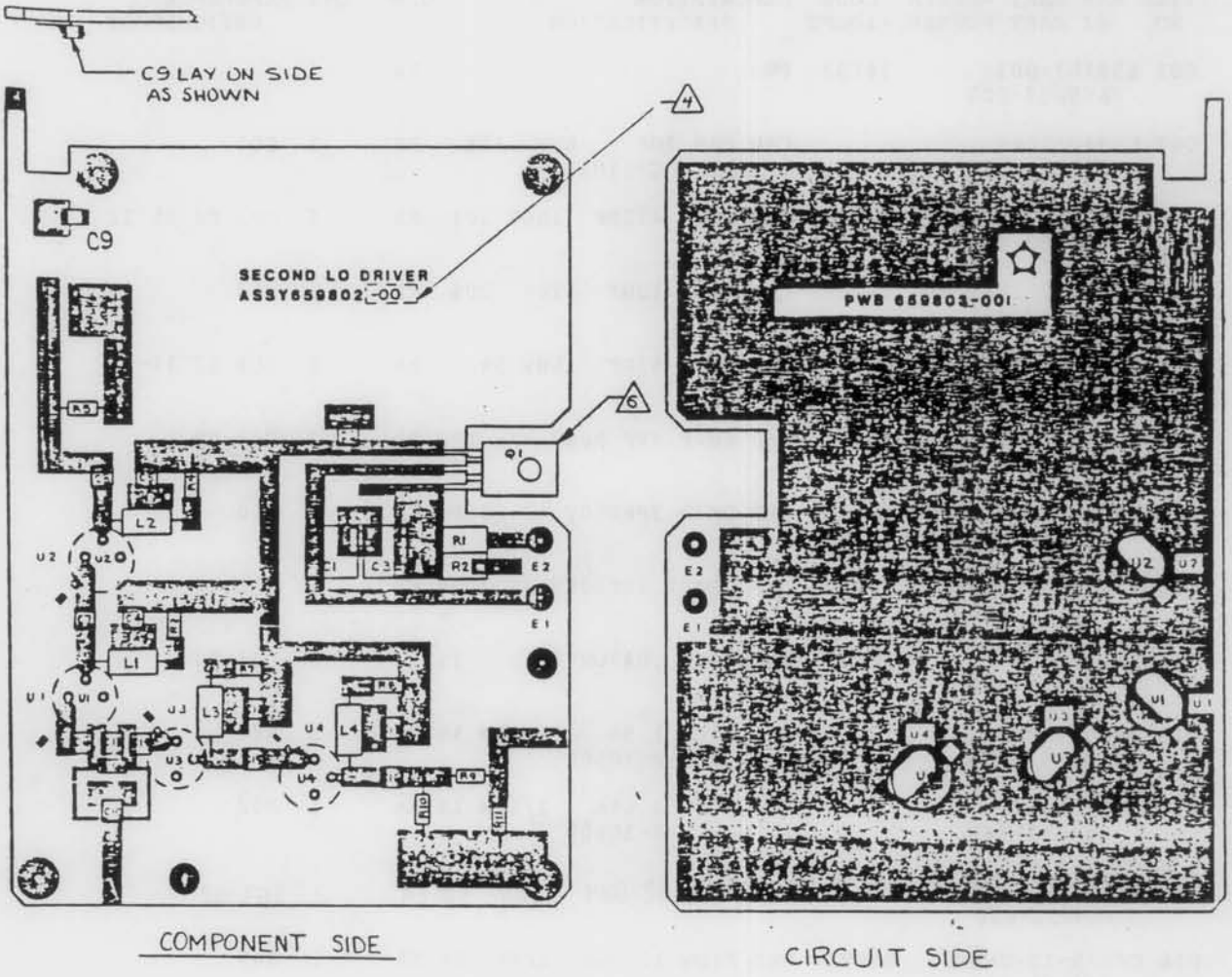
659786A

Figure 5-29. 3187.5 MHz Amplifier CCA A6A5 Parts List, Part No. 659786 (Sheet 1 of 2)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
001	659787-001 659787-001	14482	PWB	EA	1	
002	ATC100A330FP150X 990018-476	29990	CAP CHIP 33PF 150V 1%	EA	11	C01-11
003	HXTR3675 990018-478	28480	XSTR	EA	1	Q01
004	HXTR5101 990018-479	28480	XSTR	EA	1	Q02
005	MMBT3906 990018-480	28480	XSTR	EA	2	Q03 04
006	CF1/8-39K/J 744054-390	09021	RES FILM 39K 1/8W 5%	EA	1	R01
007	CF1/8-4.7K/J 744053-470	09021	RES FILM 4.7K 1/8W 5%	EA	1	R02
008	CF1/8-56-OHMS/J 744051-560	09021	RES FILM 56-OHM 1/8W 5%	EA	1	R03
009	CF1/8-10K/J 744054-100	09021	RES FILM 10K 1/8W 5%	EA	1	R04
010	CF1/8-1.2K/J 744053-120	09021	RES FILM 1.2K 1/8W 5%	EA	1	R05
011	CF1/8-47-OHMS/J 744051-470	09021	RES FILM 47-OHM 1/8W 5%	EA	1	RO6
012	659906 659906	14482	SCHEM DIAG	EA	REF	

EXPLOSION FINISHED

Figure 5-29. 3187.5 MHz Amplifier CCA A6A5 Parts List, Part NO. 659786 (Sheet 2 of 2)



1. PARTS LIST REFER PL 659802.
2. MAXIMUM COMPONENT HEIGHT ABOVE BOARD, COMP SIDE 0.20, CKT SIDE 0.19.
3. DARK AREA INDICATES CLAD.
4. MARK APPROPRIATE DASH NUMBER AFTER ASSEMBLY.
5. INSTALL U1, U2, U3 and U4 FROM CIRCUIT SIDE.
6. Q1 SHOWN FOR REF ONLY TO BE INSTALLED AT NEXT ASSEMBLY.
7. SOLDER PER MIL-STD-454.

NOTES: UNLESS OTHERWISE SPECIFIED.

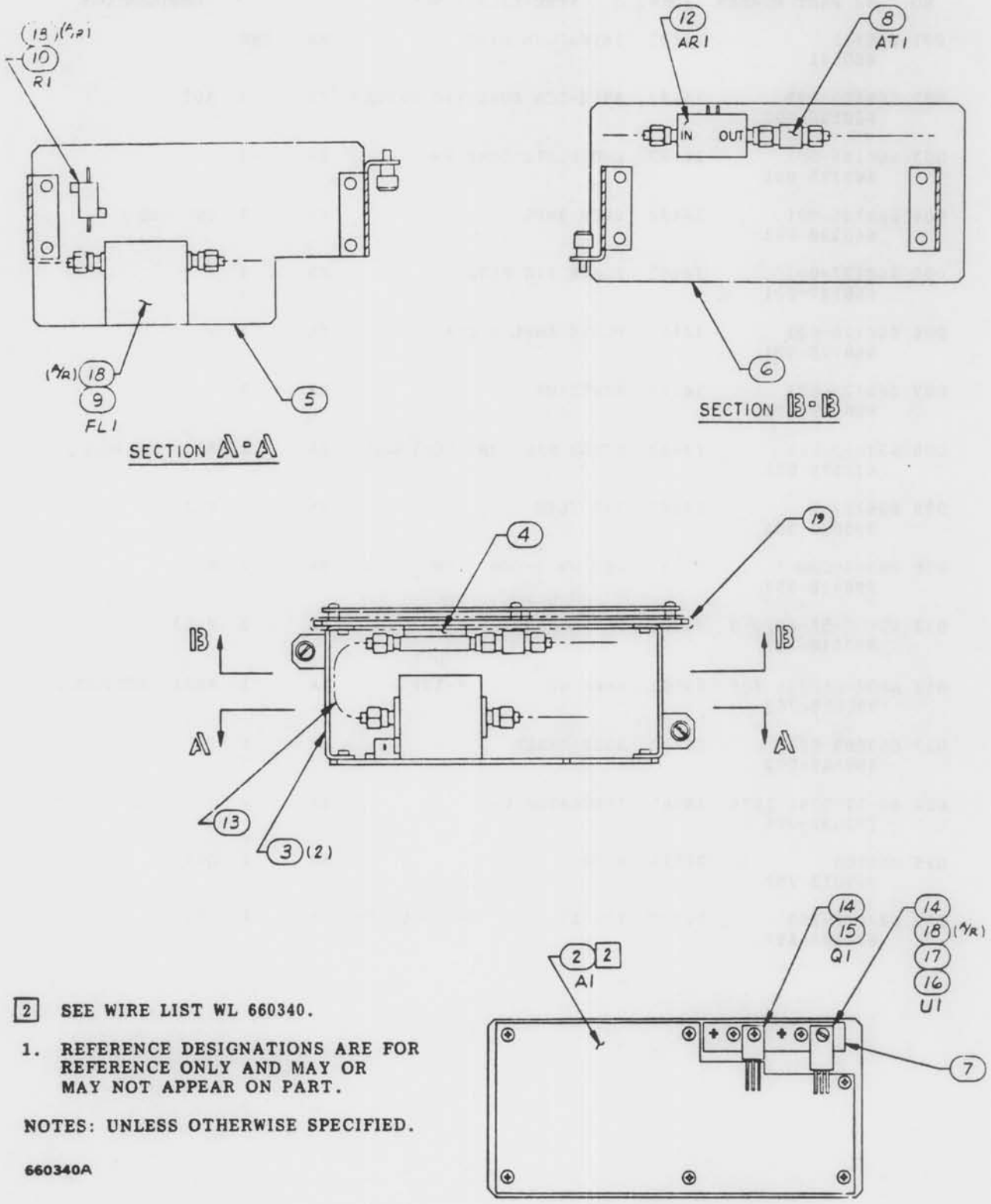
659802A

Figure 5-30. Second LO Driver CCA A6A6 Parts List, Part No. 659802 (Sheet 1 of 2)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS (Rev. A)
001	659803-001 659803-001	14482	PWB	EA	1	
002	CK06BX105K 070716-000		CAP CER 1UF 50V 10% MIL-C-11015	EA	1	C01
003	C1210E471K1GAH 756152-470	31433	CAP CHIP 470PF 100V 10%	EA	5	C02 04 05 12 13
004	MMS-020-156R-20 990018-426	14674	CAP TANT 15UF 20V 20%	EA	1	C03
005	ATC100B470JP500X 990018-427	29990	CAP CHIP 47PF 100V 5%	EA	5	C06 07 14-16
006	ATC100B2R0BP500X 990018-428	29990	CAP CHIP 2PF 500V +/-.1PF	EA	2	C08 09
007	ATC100B3R0CP500X 990018-429	29990	CAP CHIP 3PF500V +/-.25PF	EA	1	C10
008	ATC100B1R5CP500X 990018-430	29990	CAP CHIP1.5PF500V+/-.25PF	EA	1	C11
010	L10-0R047 990018-404	7W259	COIL FXD .047UH 1%	EA	4	L01-04
013	RN55C1501F 741553-150		RES FILM 1.5K 1/10W 1% MIL-R-10509	EA	1	R01
014	RN55C1651F 741553-165		RES FILM 1.65K 1/10W 1% MIL-R-10509	EA	1	R02
015	CF1/8-82-0HMS/J 744051-820	09021	RES FILM 82-OHM 1/8W 5%	EA	2	R03 07
016	CF1/8-12-0HMS/J 744051-120	09021	RES FILM 12-OHM 1/8W 5%	EA	1	R09
017	CF1/8-1K/J 744053-100	09021	RES FILM 1K 1/8W 5%	EA	1	R05
018	CF1/8-100-0HMS/J 744052-100	09021	RES FILM 100-OHM 1/8W 5%	EA	1	R06
019	CF1/8-22-0HMS/J 744051-220	09021	RES FILM 22-OHM 1/8W 5%	EA	2	R04 08
020	CF1/8-470-0HMS/J 744052-470	09021	RES FILM 470-OHM 1/8W 5%	EA	2	R10 11
021	GPD420 990018-626	24539	AMPL RF	EA	2	U01 03
022	GPD430 990018-627	24539	AMPL RF	EA	2	U02 04
023	24AWG QQ-W-343 24AWG QQ-W-343		WIRE BUS SOLID TINNED CU QQ-W-343	FT	A/R	
024	659906 659906	14482	SCHEM DIAG	EA	REF	

EXPLOSION FINISHED

Figure 5-30. Second LO Driver CCA A6A6 Parts List, Part No. 659802 (Sheet 2 of 2)



2 SEE WIRE LIST WL 660340.

1. REFERENCE DESIGNATIONS ARE FOR REFERENCE ONLY AND MAY OR MAY NOT APPEAR ON PART.

NOTES: UNLESS OTHERWISE SPECIFIED.

660340A

Figure 5-31. 1 to 4 GHz Front End A7 Parts List, Part No. 660340 (Sheet 1 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS	
001	660341 660341	14482	INTERCONN DIAG	EA	REF		
002	660120-002 660120-002	14482	ASSY-CCA DUAL YIG DRIVER	EA	1	A01	
003	660125-001 660125-001	14482	END PLATE COAX SW	EA	2		
004	660126-001 660126-001	14482	SPCR AMPL	EA	1	SEE NOTE 3	
005	660127-001 660127-001	14482	PLATE YIG FLTR	EA	1		
006	660128-001 660128-001	14482	PLATE AMPL & CCA	EA	1		
007	660129-001 660129-001	14482	HEATSINK	EA	1		
008	632675-021 632675-021	14482	ATTEN PAD 1DB DC-18GHZ	EA	1	AT1	SEE NOTE 1
009	WJ5292-2 990006-950	14482	YIG FLTR	EA	1	FL1	
010	RH5-4-OHM-1 990018-757	91637	RES WW 4-OHM 5W 1%	EA	1	R1	
011	UT-LC-85-5000-9 990018-775	93306	CABLE FLTR	EA	1	FL03	
012	AFD2-010045-40* 990018-763	33592	AMPL RF *-12P	EA	1	AR01	SEE NOTE 2
013	659869-002 659869-002	14482	ASSY-CABLE	EA	1		
014	60-11-5791-1674 702028-001	18565	INSULATOR PAD	EA	2		
015	MJE700 990018-752	04713	XSTR	EA	1	Q01	
016	627603-192 627603-192	14482	IC-317 CT SPCL PKG	EA	1	U01	

Figure 5-31. 1 to 4 GHz Front End A7 Parts List,
Part No. 660340 (Sheet 2 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
017	MS18211-3 574041-000		SCR FL HD NYL 4-40X1/4 FF-S-92	EA	1	
018	340 405000-150	71984	COMPOUND HTSINK 5 OZ TUBE	EA	A/R	

EXPLOSION FINISHED

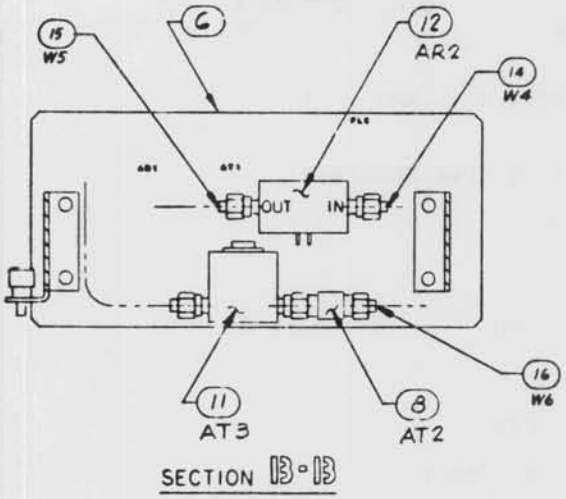
NOTES: UNLESS OTHERWISE SPECIFIED

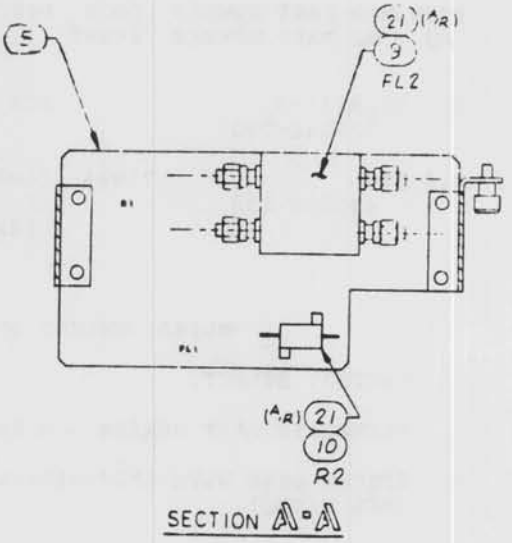
1: FACTORY SELECT.

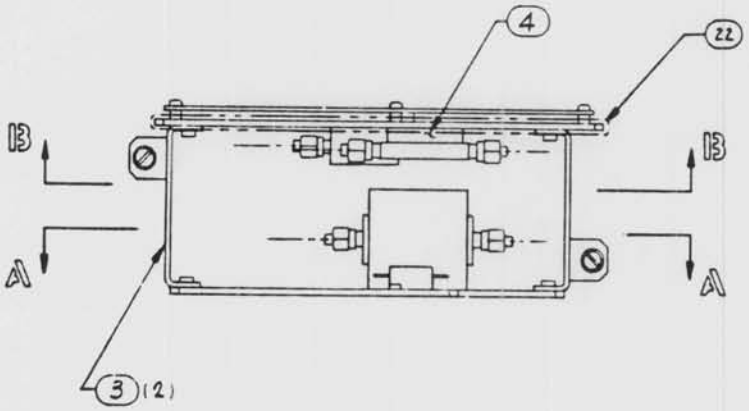
2: ALTERNATE PART NUMBER AFM/045-4018-36 MFG CTT.

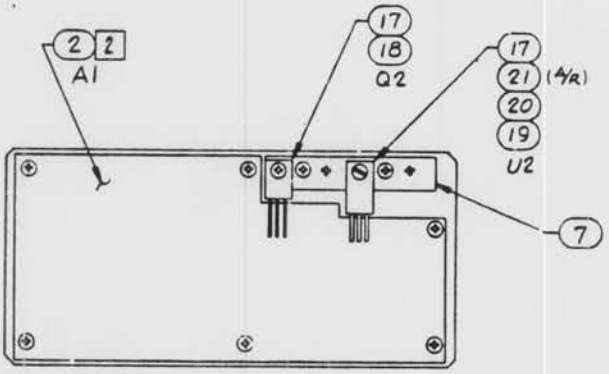
3: SPACER USED WITH AFD2-010045-40-12P AMPLIFIER ONLY (MFG MITEQ).

Figure 5-31. 1 to 4 GHz Front End A7 Parts List, Part No. 660340 (Sheet 3 of 3)









[2] SEE WIRE LIST WL 660380.

1. REFERENCE DESIGNATIONS ARE FOR REFERENCE ONLY AND MAY OR MAY NOT APPEAR ON PART.

NOTES: UNLESS OTHERWISE SPECIFIED.

660380A

Figure 5-32. 4.0 to 12.4 GHz Front End A7 Parts List, Part No. 660380 (Sheet 1 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS	
001	660381 660381	14482	INTERCONN DIAG	EA	REF		
002	660120-003 660120-003	14482	ASSY-CCA DUAL YIG DRIVER	EA	1	A01	
003	660125-001 660125-001	14482	END PLATE COAX SW	EA	2		
004	660126-001 660126-001	14482	SPCR AMPL	EA	1	SEE NOTE 3	
005	660127-001 660127-001	14482	PLATE YIG FLTR	EA	1		
006	660128-001 660128-001	14482	PLATE AMPL & CCA	EA	1		
007	660129-001 660129-001	14482	HEATSINK	EA	1		
008	632675-021 632675-021	14482	ATTEN PAD 1DB DC-18GHZ	EA	1	AT02	SEE NOTE 1
009	WJ5024-10 990006-951	14482	YIG FLTR	EA	1	FL02	
010	RH5-1-OHM-1 090999-015	91637	RES WW 1-OHM 5W 1%	EA	1	R02	
011	VF1663 990018-758	1Y147	ISOLATOR	EA	1	AT03	
012	AFD3-040124-50 990018-762	33592	AMPL RF	EA	1	AR02	SEE NOTE 2
013	659869-003 659869-003	14482	ASSY-CABLE	EA	1		
014	659869-004 659869-004	14482	ASSY-CABLE	EA	1		
015	659869-005 659869-005	14482	ASSY-CABLE	EA	1		
016	659869-006 659869-006	14482	ASSY-CABLE	EA	1		
017	60-11-5791-1674 702028-001	18565	INSULATOR PAD	EA	2		
018	MJE700 990018-752	04713	XSTR	EA	1	Q02	
019	627603-192 627603-192	14482	IC-317 CT SPCL PKG	EA	1	U02	

Figure 5-32. 4.0 to 12.4 GHz Front End A7 Parts List, Part No. 660380 (Sheet 2 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
020	MS18211-3 574041-000		SCR FL HD NYL 4-40X1/4 FF-S-92	EA	1	
021	340 405000-150	71984	COMPOUND HTSINK 5 OZ TUBE	EA	A/R	

EXPLOSION FINISHED

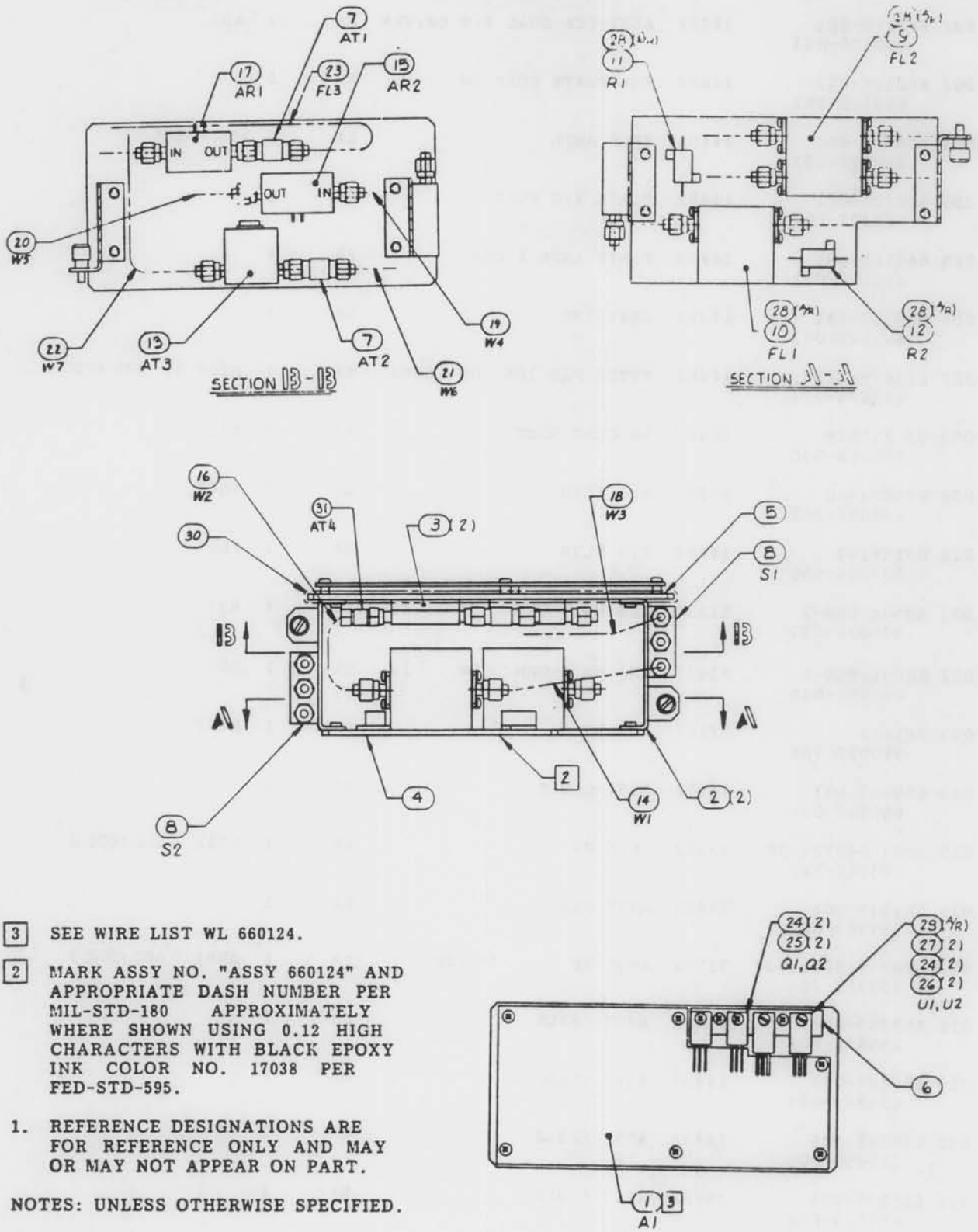
NOTES: UNLESS OTHERWISE SPECIFIED

1: FACTORY SELECT.

2: ALTERNATE PART NUMBER AFM/124-5518-36 MFG CTT.

3: SPACER USED WITH AFD3-040124-50 AMPLIFIER ONLY (MFG MITEQ).

Figure 5-32. 4.0 to 12.4 GHz Front End A7 Parts List, Part No. 660380 (Sheet 3 of 3)



3 SEE WIRE LIST WL 660124.

2 MARK ASSY NO. "ASSY 660124" AND APPROPRIATE DASH NUMBER PER MIL-STD-180 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH BLACK EPOXY INK COLOR NO. 17038 PER FED-STD-595.

1. REFERENCE DESIGNATIONS ARE FOR REFERENCE ONLY AND MAY OR MAY NOT APPEAR ON PART.

NOTES: UNLESS OTHERWISE SPECIFIED.

660124 B

Figure 5-33. 1.0 to 12.4 GHz Front End A7 Parts List, Part No. 660124 (Sheet 1 of 3)

Rev. B

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS	
001	660120-001 660120-001	14482	ASSY-CCA DUAL YIG DRIVER	EA	1	A01	
002	660125-001 660125-001	14482	END PLATE COAX SW	EA	2		
003	660126-001 660126-001	14482	SPCR AMPL	EA	2	SEE NOTE 4	
004	660127-001 660127-001	14482	PLATE YIG FLTR	EA	1		
005	660128-001 660128-001	14482	PLATE AMPL & CCA	EA	1		
006	660129-001 660129-001	14482	HEATSINK	EA	1		
007	632675-021 632675-021	14482	ATTEN PAD 1DB DC-18GHZ	EA	2	AT01 02	SEE NOTE 1
008	D3-417E28 990018-550	50667	SW COAX SPDT	EA	2	S01 S02	
009	WJ5024-10 990006-951	14482	YIG FLTR	EA	1	FL02	
010	WJ5292-2 990006-950	14482	YIG FLTR	EA	1	FL01	
011	RH5-4-OHM-1 990018-757	91637	RES WW 4-OHM 5W 1%	EA	1	R01	
012	RH5-1-OHM-1 090999-015	91637	RES WW 1-OHM 5W 1%	EA	1	R02	
013	VF1663 990018-758	1Y147	ISOLATOR	EA	1	AT03	
014	659869-001 659869-001	14482	ASSY-CABLE	EA	1		
015	AFD3-040124-50 990018-762	33592	AMPL RF	EA	1	AR02	SEE NOTE 2
016	659869-002 659869-002	14482	ASSY-CABLE	EA	1		
017	AFD2-010045-40* 990018-763	33592	AMPL RF *-12P	EA	1	AR01	SEE NOTE 3
018	659869-003 659869-003	14482	ASSY-CABLE	EA	1		
019	659869-004 659869-004	14482	ASSY-CABLE	EA	1		
020	659869-005 659869-005	14482	ASSY-CABLE	EA	1		
021	659869-006 659869-006	14482	ASSY-CABLE	EA	1		
022	659869-007 659869-007	14482	ASSY-CABLE	EA	1		

Figure 5-33. 1.0 to 12.4 GHz Front End A7 Parts List, Part No. 660124 (Sheet 2 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS	
023	659869-008 659869-008	14482	ASSY-CABLE	EA	1	W08 (FL03)	
024	60-11-5791-1674 702028-001	18565	INSULATOR PAD	EA	4		
025	MJE700 990018-752	04713	XSTR	EA	2	Q01 Q02	
026	627603-192 627603-192	14482	IC-317 CT SPCL PKG	EA	2	U01 U02	
027	MS18211-3 574041-000		SCR FL HD NYL 4-40X1/4 FF-S-92	EA	2		
028	340 405000-150	71984	COMPOUND HTSINK 5 OZ TUBE	EA	AR		
029	660130 660130	14482	INTERCONN DIAG	EA	REF		
030	MS21266-3N 584200-005		GROMMET PLSTC EDGING MIL-G-22529	EA	AR		
031	632675-020 632675-020	14482	ATTEN PAD 0DB DC-18GHZ	EA	1	AT04	SEE NOTE 5

EXPLOSION FINISHED

NOTES: UNLESS OTHERWISE SPECIFIED

1: FACTORY SELECT.

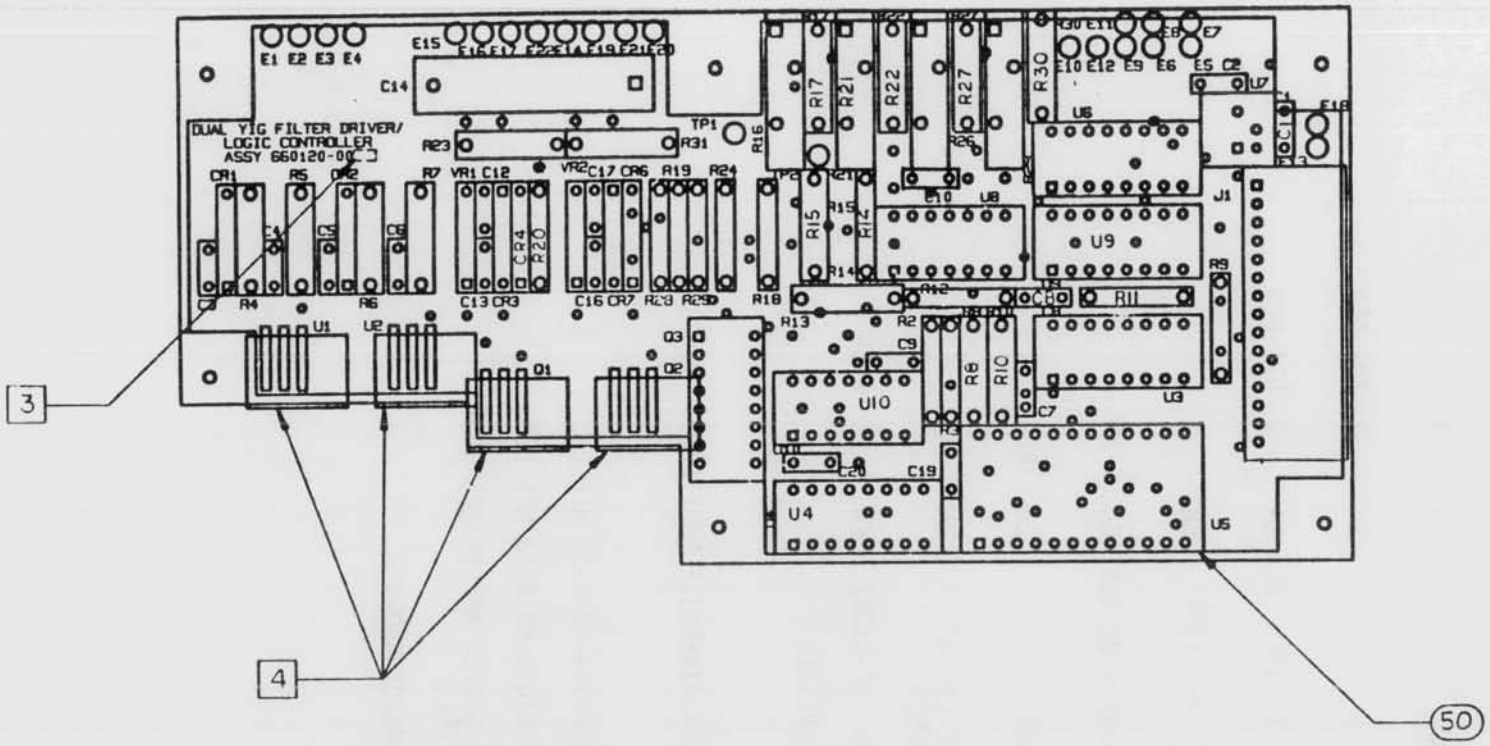
2: ALTERNATE PART NUMBER AFM/124-5518-36 MFG CTT.

3: ALTERNATE PART NUMBER AFM/045-4018-36 MFG CTT.

4: SPACERS USED WITH "AFD" SERIES AMPLIFIERS ONLY MFG MITEQ (1 PER AMPLIFIER).

5: FACTORY SELECT NOMINAL VALUE SHOWN.

Figure 5-33. 1.0 to 12.4 GHz Front End A7 Parts List, Part No. 660124 (Sheet 3 of 3)



4 REFERENCE ONLY. INSTALLED AT NEXT ASSEMBLY.

3 MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH WHITE INK COLOR NO. 17875 PER FED-STD-595.

2. OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

NOTES: UNLESS OTHERWISE SPECIFIED.

660120B

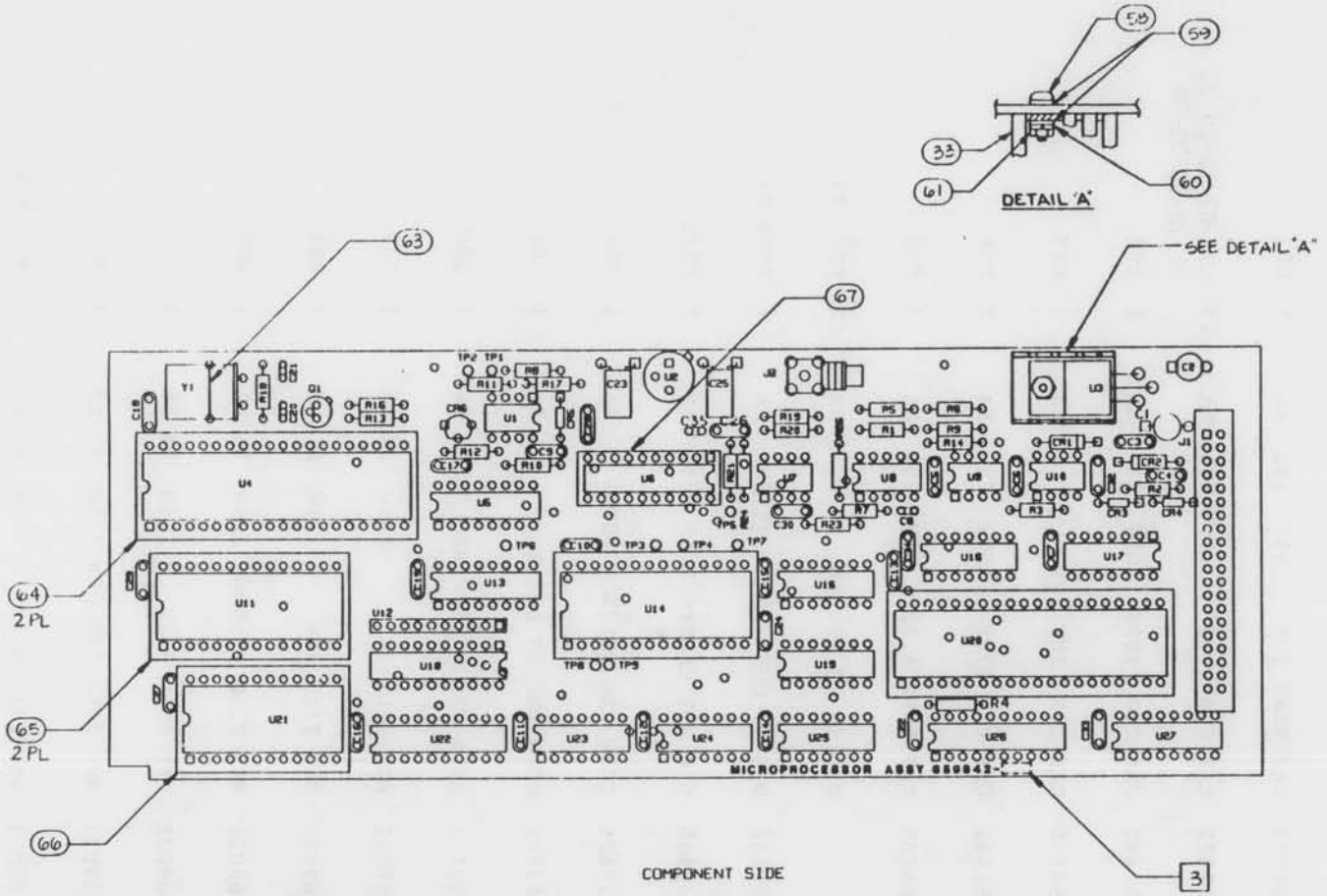
Figure 5-34. Dual YIG Filter Driver Logic Controller CCA A7A1 Parts List, Part No. 660120 (Sheet 1 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS Rev. C
001	660121-001 660121-001	14482	PWB	EA	1	
002	660123 660123	14482	SCHEM DIAG	EA	REF	
004	CK06BX224K 751105-220		CAP CER .22UF 50V 10% MIL-C-11015	EA	1	C01
005	CK06BX105K 070716-000		CAP CER 1UF 50V 10% MIL-C-11015	EA	11	C02-10 12 19
006	660073-104 660073-104	14482	CAP CER .1UF 50V 20%	EA	1	C20
007	CS13BD686K 754037-680		CAP TANT 68UF 15V 10% MIL-C-26655	EA	1	C14
010	CK05BX152K 750153-150		CAP CER 1500PF 100V 10% MIL-C-11015	EA	2	C13 16
013	1N4003 773000-006	80131	DIO RECT 200PRV 1A	EA	2	CR01 02
014	1N914 772000-001A	81350	DIO SIG SW 100V	EA	4	CR03 04 06 07
015	1N961 771000-001A		DIO ZR 10.0V .4W 20% A398	EA	2	VR01 02
018	22-05-7155 799100-006	27264	HEADER 15-CKT	EA	1	J01
019	CK05BX104K 750105-100		CAP CER .1UF 50V 10% MIL-C-11015	EA	1	C17
021	627603-105 627603-105	14482	IC-309 CT MET CAN	EA	1	U07
022	627607-855 627607-855	14482	IC-74HC237 CT PLSTC DIP	EA	1	U06
023	627603-104 627603-104	14482	IC-3658 CT PLSTC DIP	EA	1	U09
024	627607-098 627607-098	14482	IC-74LS05 CT PLSTC DIP	EA	1	U10
026	627604-087 627604-087	14482	IC-4094 CT PLSTC DIP	EA	2	U03 04
027	627607-540 627607-540	14482	IC-701 IT MET DIP	EA	1	U05
028	627603-328 627603-328	14482	IC-34004 CT PLSTC DIP	EA	1	U08
029	627603-076 627603-076	14482	IC-3096 MT CER DIP	EA	1	Q03
033	CF1/4-2.2K/J 744073-220	09021	RES FILM 2.2K 1/4W 5%	EA	2	R02 03

Figure 5-34. Dual YIG Filter Driver Logic Controller CCA A7A1 Parts List, Part No. 660120 (Sheet 2 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
034	RN55C2430F 741552-243		RES FILM 243-OHM 1/10W 1% MIL-R-10509	EA	2	R04 06
035	RN55C2741F 741553-274		RES FILM 2.74K 1/10W 1% MIL-R-10509	EA	2	R05 07
036	RN55C1002F 741554-100		RES FILM 10K 1/10W 1% MIL-R-10509	EA	4	R08 10 13 15
037	RN55C2742F 741554-274		RES FILM 27.4K 1/10W 1% MIL-R-10509	EA	1	R17
038	RN55C3241F 741553-324		RES FILM 3.24K 1/10W 1% MIL-R-10509	EA	1	R22
039	RN55C3322F 741554-332		RES FILM 33.2K 1/10W 1% MIL-R-10509	EA	1	R27
040	RN55C1822F 741554-182		RES FILM 18.2K 1/10W 1% MIL-R-10509	EA	1	R30
041	RN55C1001F 741553-100		RES FILM 1K 1/10W 1% MIL-R-10509	EA	2	R23 31
042	CF1/4-3.3K/J 744073-330	09021	RES FILM 3.3K 1/4W 5%	EA	6	R18-20 24 25 28
043	CF1/4-10-0HMS/J 744071-100	09021	RES FILM 10-OHM 1/4W 5%	EA	4	R09 11 12 14
046	89PR1K 748063-100	73138	RES VAR SCR ADJ 1K 10%	EA	1	R21
047	89PR2K 990018-756	73138	RES VAR SCR ADJ 2K	EA	3	R16 26 29
050	524-AG37D 990009-683	91506	SOCKET PC 24CONT DIP	EA	1	XU05
			EXPLOSION FINISHED			

Figure 5-34. Dual YIG Filter Driver Logic Controller CCA A7A1 Parts List, Part No. 660120 (Sheet 3 of 3)



3 MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH WHITE INK COLOR NO. 17875 PER FED-STD-595.

2. OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

NOTES: UNLESS OTHERWISE SPECIFIED.

659842 B

Figure 5-35. Microprocessor CCA A8 Parts List, Part No. 659842 (Sheet 1 of 5)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS (Rev. B)
001	659843-001 659843-001	14482	PWB	EA	1	
002	196D226X0015KE3 990018-463	56289	CAP TANT 22UF 15V 20%	EA	1	C01
003	196D105X0035HE3 990018-464	56289	CAP TANT 1UF 35V 20%	EA	1	C02
004	660073-104 660073-104	14482	CAP CER .1UF 50V 20%	EA	25	C03-07 10-19 22 24 26-30 32-34
005	150-100-NP0-221G 759162-220	51642	CAP CER 220PF 100V 2%	EA	1	C08
006	C330C105M5V5CA 752100-100	59660	CAP CER 1UF 50V	EA	1	C09
007	150-100-NP0-270G 759161-270	51642	CAP CER 27PF 100V 2%	EA	2	C20 21
008	196D475X0035JE3 990018-349	56289	CAP TANT 4.7UF 35V 20%	EA	2	C23 25
009	1N746A 771000-016		DIO ZR 3.3V .4W 5% DO7	EA	2	CR01 02
010	1N4449 775000-001	80131	DIO HI COND HS SW 75PPV	EA	2	CR03 04
011	5082-2800 775000-002	28480	DIO HOT CARRER 1/4W 70V	EA	1	CR05
013	66506-025 990018-465	22526	CONN HDR DBL ROW 40POS	EA	1	J01
014	1010-7511-000 990018-442	01121	CONN SMC RT ANGLE	EA	1	J02
015	2N2222A 780000-002B	80131	XSTR NPN HI-SPD MED PWR	EA	1	Q01
016	CF1/4-1K/J 744073-100	09021	RES FILM 1K 1/4W 5%	EA	1	R03
017	CF1/4-10K/J 744074-100	09021	RES FILM 10K 1/4W 5%	EA	1	R02
018	CF1/4-47-OHMS/J 744071-470	09021	RES FILM 47-OHM 1/4W 5%	EA	1	R05
019	CF1/4-4.7K/J 744073-470	09021	RES FILM 4.7K 1/4W 5%	EA	1	R01
020	CF1/4-100-OHMS/J 744072-100	09021	RES FILM 100-OHM 1/4W 5%	EA	1	R07
021	CF1/4-470K/J 744075-470	09021	RES FILM 470K 1/4W 5%	EA	2	R10 R14
023	RN55C1332F 741554-133		RES FILM 13.3K 1/10W 1% MIL-R-10509	EA	1	R11

Figure 5-35. Microprocessor CCA A8 Parts List, Part No. 659842 (Sheet 2 of 5)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
024	CF1/4-510-OHMS/J 744072-510	09021	RES FILM 510-OHM 1/4W 5%	EA	1	R12
025	CF1/4-2K/J 744073-200	09021	RES FILM 2K 1/4W 5%	EA	2	R13 16
026	CF1/4-2.2K/J 744073-220	09021	RES FILM 2.2K 1/4W 5%	EA	1	R04
027	RN55C4641F 741553-464		RES FILM 4.64K 1/10W 1% MIL-R-10509	EA	1	R17
028	CF1/4-1M/J 744076-100	09021	RES FILM 1MEG 1/4W 5%	EA	1	R18
029	CF1/4-10-OHMS/J 744071-100	09021	RES FILM 10-OHM 1/4W 5%	EA	3	R19 20 23
030	CF1/4-750K/J 990018-791	09021	RES FILM 750K 1/4W 5%	EA	1	R8
031	RN55C1003F 741555-100		RES FILM 100K 1/10W 1% MIL-R-10509	EA	2	R21 24
032	RN55C5112F 741554-511		RES FILM 51.1K 1/10W 1% MIL-R-10509	EA	1	R26
033	6078B 990018-472	13103	HEATSINK	EA	1	RA01
034	627603-233 627603-233	14482	IC-393 CT PLSTC DIP	EA	1	U01
035	627605-712 627605-712	14482	IC-581 CT MET CAN	EA	1	U02
036	627603-114 627603-114	14482	IC-340T-5.0 CT TO-220	EA	1	U03
037	627608-012 627608-012	14482	IC-800 CT PLSTC DIP	EA	1	U04
038	627607-359 627607-359	14482	IC-74HC138 CT PLSTC DIP	EA	2	U05 13
039	627608-028 627608-028	14482	IC-830 CT MET DIP	EA	1	U06
040	627603-326 627603-326	14482	IC-34002 CT PLSTC DIP	EA	1	U07
041	627602-003 627602-003	14482	IC-0002 CT PLSTC DIP	EA	1	U08
042	627607-795 627607-795	14482	IC-75140 CT PLSTC DIP	EA	1	U09
043	627607-293 627607-293	14482	IC-75150 CT PLSTC DIP	EA	1	U10
044	633000-036 633000-036	14482	IC-PROM 8192X8TS200 C D	EA	1	U11

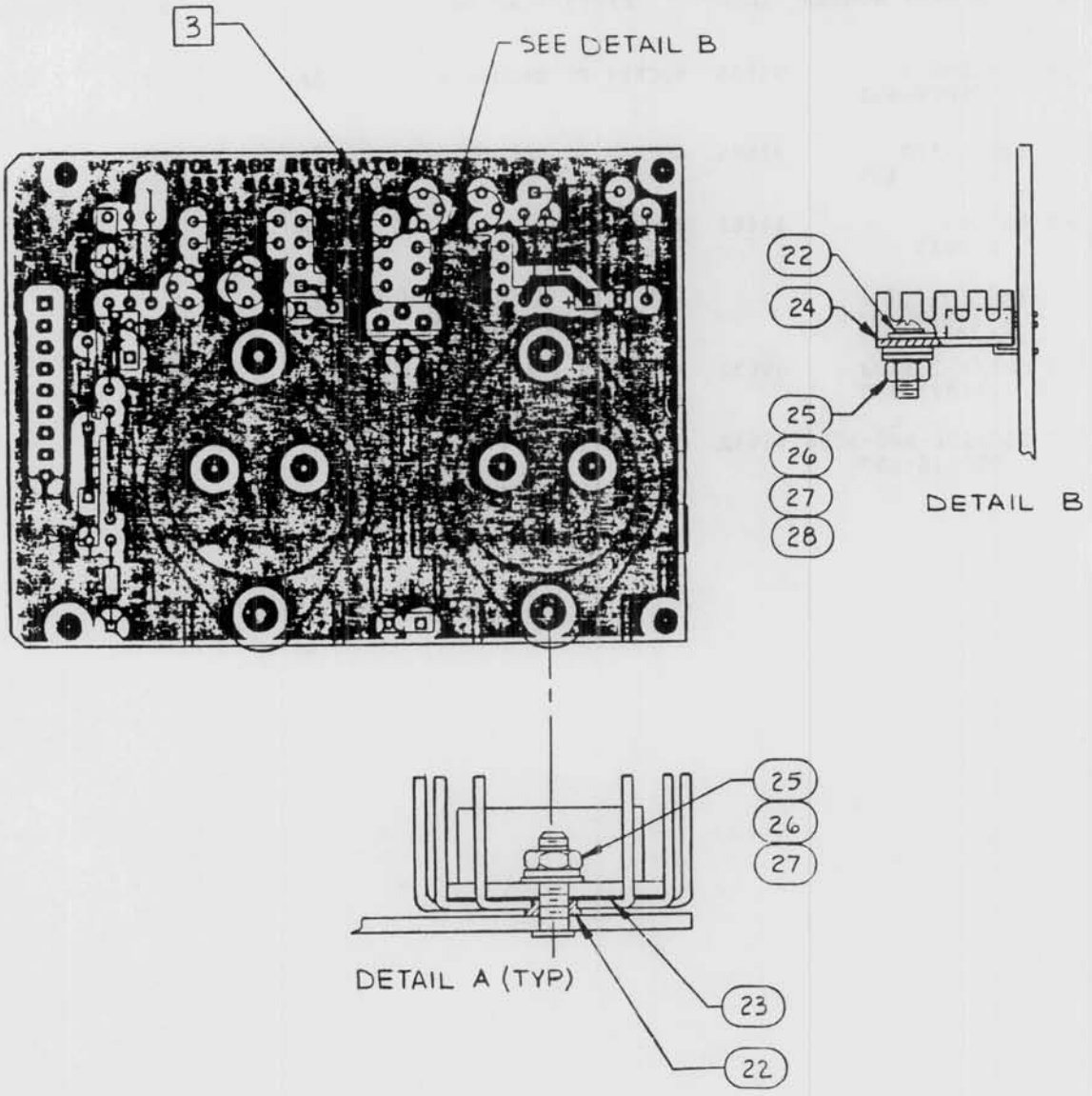
Figure 5-35. Microprocessor CCA A8 Parts List, Part No. 659842
(Sheet 3 of 5)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
045	110A103 990018-473	01121	RES NET SIP 10P 10K 2%	EA	1	U12
046	627608-040 627608-040	14482	IC-858 CT PLSTC DIP	EA	1	U14
047	627607-103 627607-103	14482	IC-74HC04 CT PLSTC DIP	EA	2	U15 24
048	627607-107 627607-107	14482	IC-74HC08 CT PLSTC DIP	EA	2	U16 17
049	1-435704-0 990018-474	00779	PROGRAMMABLE SHUNT (DIP)	EA	1	U18
050	627607-826 627607-826	14482	IC-74HC32 CT PLSTC DIP	EA	1	U19
051	627608-038 627608-038	14482	IC-810 CT PLSTC DIP	EA	1	U20
052	627606-103 627606-103	14482	IC-6116-2 CT PLSTC DIP	EA	1	U21
053	627607-641 627607-641	14482	IC-74HC373 CT PLSTC DIP	EA	2	U22 26
054	627607-072 627607-072	14482	IC-74HC00 CT PLSTC DIP	EA	1	U23
055	627607-172 627607-172	14482	IC-74HC73 CT PLSTC DIP	EA	1	U25
055	627607-659 627607-659	14482	IC-74HC365 CT PLSTC DIP	EA	1	U27
057	MP042 990018-660	75378	XTAL/QUARTZ 4.91520 MHZ	EA	1	Y01
058	MS51957-14 553040-312		SCR PAN HD 4-40X5/16 FF-S-92	EA	1	
059	MS15795-803 990018-457		WASHER FL NO 4 FF-W-92	EA	2	
060	MS35338-135 580230-004		WASHER LCK NO 4 FF-W-84	EA	1	
061	NAS671C4 581210-440		NUT HEX SM PATT 4-40 MIL-S-933	EA	1	
062	627603-317 627603-317	14482	IC-385 CT PLSTC CAN	EA	1	CR06
063	22AWG-QQW343 442222-000		WIRE BUS SOLID TINNED CU QQ-W-343	FT	AR	
064	540-AG37D 990009-491	91506	SOCKET PC 40CONT DIP	EA	2	XU04 20
065	528-AG37D 990009-684	91506	SOCKET PC 28CONT DIP	EA	2	XU11 14

Figure 5-35. Microprocessor CCA A8 Parts List, Part No. 659842 (Sheet 4 of 5)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
066	524-AG37D 990009-683	91506	SOCKET PC 24CONT DIP	EA	1	XU21
067	520-AG37D 990009-155	91506	SOCKET PC 20CONT DIP	EA	1	XU06
068	659845 659845	14482	SCHEM DIAG	EA	REF	
069	RN55C1622F 741554-162		RES FILM 16.2K 1/10W 1% MIL-R-10509	EA	1	R09
070	CF1/4-7.5K/J 744073-750	09021	RES FILM 7.5K 1/4W 5%	EA	1	R06
071	150-100-NP0-500G 990018-857	51642	CAP CER 50PF 100V 2%	EA	1	C35
			EXPLOSION FINISHED			

Figure 5-35. Microprocessor CCA A8 Parts List, Part No. 659842
(Sheet 5 of 5)



[3] MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH BLACK INK COLOR NO. 17038 PER FED-STD-595.

2. OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

NOTES: UNLESS OTHERWISE SPECIFIED.

659846

Figure 5-36. Voltage Regulator CCA A10 Parts List, Part No. 659846 (Sheet 1 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
001	659847-001 659847-001	14482	PWB	EA	1	
002	MMM-035-105R-20 990018-450	14674	CAP TANT 1UF 35V 20%	EA	6	C01-06
003	1N4005 770000-005	80131	DIO	EA	4	CR01-04
004	2N2222A 780000-002B	80131	XSTR NPN HI-SPD MED PWR	EA	3	Q01 02 04
006	JAN2N2907 780000-001C		XSTR MIL-S-19500	EA	1	Q05
007	RCR20G* RCR20G*		RES CMPSN FAC SEL 5% MIL-R-39008	EA	1	R16 SEE NOTE 1
008	CF1/4-10K/J 744074-100	09021	RES FILM 10K 1/4W 5%	EA	1	R01
009	CF1/4-100K/J 744075-100	09021	RES FILM 100K 1/4W 5%	EA	1	R02
010	CF1/4-4.7K/J 744073-470	09021	RES FILM 4.7K 1/4W 5%	EA	1	R03
011	CF1/4-1K/J 744073-100	09021	RES FILM 1K 1/4W 5%	EA	3	R04 08 13
012	RN55C8250F 741552-825		RES FILM 825-OHM 1/10W 1% MIL-R-10509	EA	1	R05
013	RN55C2430F 741552-243		RES FILM 243-OHM 1/10W 1% MIL-R-10509	EA	3	R06 10 15
015	RN55C2741F 741553-274		RES FILM 2.74K 1/10W 1% MIL-R-10509	EA	2	R09 14
016	CF1/4-8.2K/J 744073-820	09021	RES FILM 8.2K 1/4W 5%	EA	1	R11
017	CF1/4-27K/J 744074-270	09021	RES FILM 27K 1/4W 5%	EA	1	R12
018	627603-220 627603-220	14482	IC-350 CT MET CAN	EA	2	U01 02
019	627603-304 627603-304	14482	IC-337 CT SPCL PKG	EA	1	U03
020	LAT03B3CB 790040-002	98978	HEATSINK TO-3	EA	2	RA01 02
021	5970C 790040-003	30161	HEATSINK TO-220	EA	1	RA03
022	B51547F015 500060-013	04713	BUSHING NYL SHOULDER	EA	5	
023	60-11-4511-1671 702028-002	18565	INSULATOR PAD TO-3	EA	2	

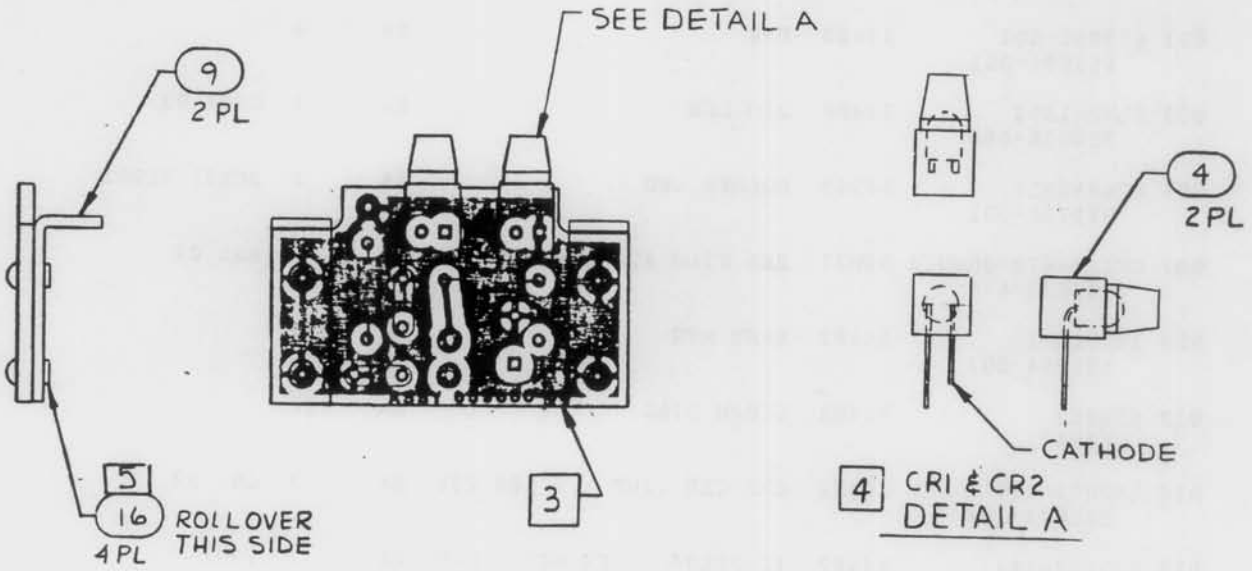
Figure 5-36. Voltage Regulator CCA A10 Parts List, Part No. 659846 (Sheet 2 of 3)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
024	1009-58 702028-003	30161	INSULATOR PAD TO-220	EA	1	
025	MS15795-803 990018-457		WASHER FL NO 4 FF-W-92	EA	5	
026	MS35338-135 580230-004		WASHER LCK NO 4 FF-W-84	EA	5	
027	NAS671C4 581210-440		NUT HEX SM PATT 4-40 MIL-S-933	EA	5	
028	MS51957-14 553040-312		SCR PAN HD 4-40X5/16 FF-S-92	EA	1	
039	659849 659849	14482	SCHEM DIAG	EA	REF	
041	22-23-2091 799100-014	27264	CONN 9PIN	EA	1	J01
			EXPLOSION FINISHED			

NOTES: UNLESS OTHERWISE SPECIFIED

1. FACTORY SELECT

Figure 5-36. Voltage Regulator CCA A10 Parts List, Part No. 659846 (Sheet 3 of 3)



[5] INSTALL ITEM 9 AFTER ASSY USING ITEM 16.

[4] SNAP LED INTO LENS, INSERT LEADS THROUGH HOLE IN MOUNT BASE, CLOSE MOUNT BENDING LEADS INTO POSITION (NOTE CATHODE)

[3] MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH WHITE INK COLOR NO. 17875 PER FED-STD-595.

2 OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

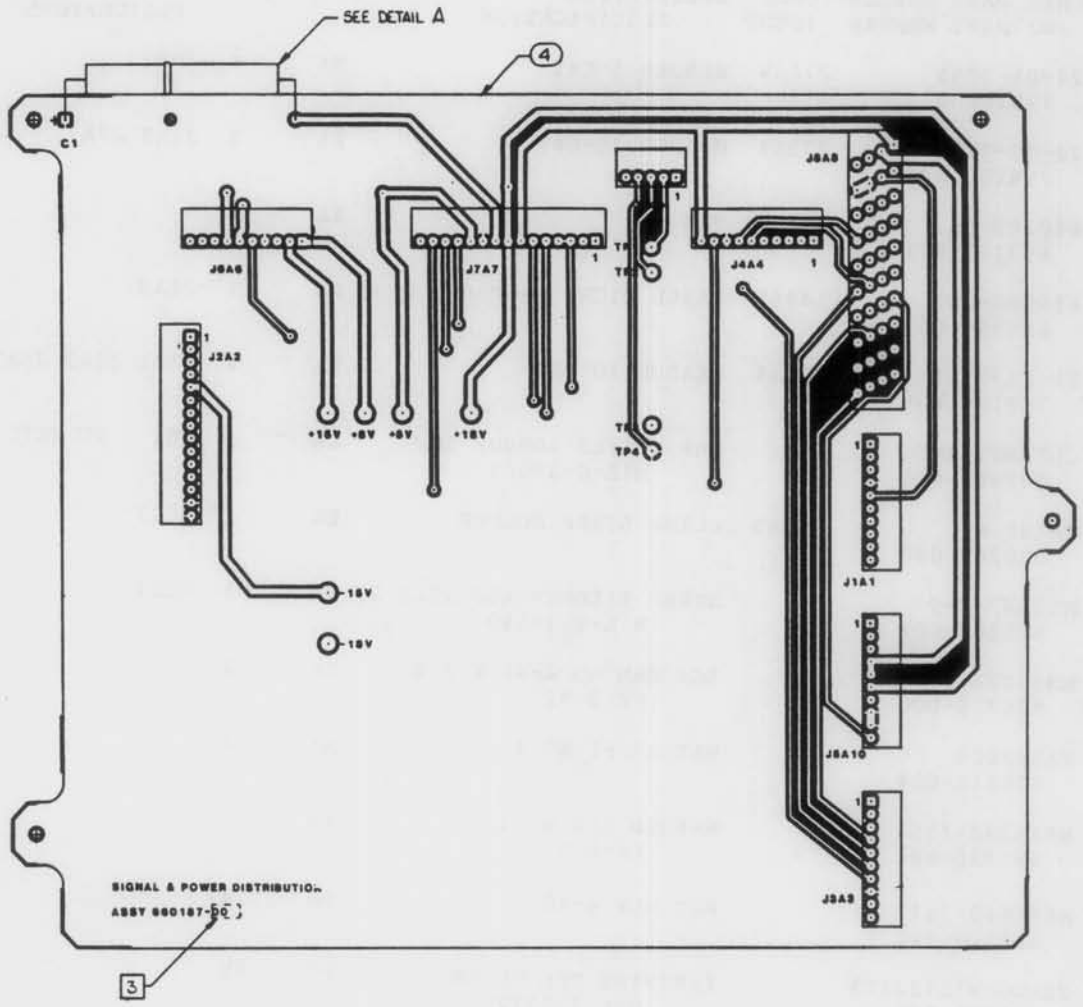
NOTES: UNLESS OTHERWISE SPECIFIED.

659850A

Figure 5-37. LED CCA A11 Parts List, Part No. 659850 (Sheet 1 of 2)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS
001	659851-001 659851-001	14482	PWB	EA	1	
003	HLMP-1302 990018-460	28480	DIO LED	EA	2	CR01 02
004	PCL490RTP 779100-001	56769	HOLDER LED	EA	2	XCR01 XCR02
007	CF1/4-470-OHMS/J 744072-470	09021	RES FILM 470-OHM 1/4W 5%	EA	2	R01 02
009	180513-1 659854-001	14482	BRKT MTG	EA	2	
013	659853 659853	14482	SCHEM DIAG	EA	REF	
014	660073-104 660073-104	14482	CAP CER .1UF 50V 20%	EA	2	C01 02
015	627607-694 627607-694	14482	IC-78L05 CT MET CAN	EA	1	VR01
016	MS20426A3-4 990016-066		RIVET 3/32DIA X 1/4 LG MIL-R-5674 EXPLOSION FINISHED	EA	1	

Figure 5-37. LED CCA A11 Parts List, Part No. 659850 (Sheet 2 of 2)



3 MARK DASH NUMBER PER MIL-STD-130 APPROXIMATELY WHERE SHOWN USING 0.12 HIGH CHARACTERS WITH WHITE INK COLOR NO. 17875 PER FED-STD-595.

2. OBSERVE POLARITY OF CAPACITORS AND SEMICONDUCTOR DEVICES.

1. SOLDER PER MIL-STD-454.

NOTES: UNLESS OTHERWISE SPECIFIED.

660187.B

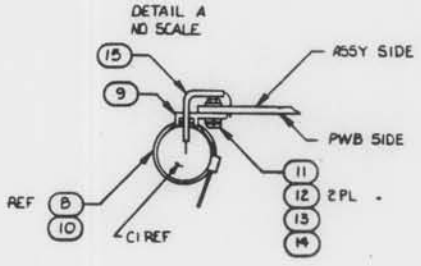


Figure 5-38. Signal and Power Distribution (Tuner Junction Box) CCA A12 Parts List, Part No. 660187 (Sheet 1 of 2)

ITEM NO	MFR PART NUMBER / WJ PART NUMBER	CODE IDENT	DESCRIPTION / SPECIFICATION	U/M	QTY	REFERENCE DESIGNATORS (Rev. B)
001	22-05-7055 799100-004	27264	HEADER 5-CKT	EA	1	J9A9
003	22-05-7155 799100-006	27264	HEADER 15-CKT	EA	2	J2A2 J7A7
004	660188-001 660188-001	14482	PWB	EA	1	
005	659890-001 659890-001	14482	CABLE MICRO PROC PWR DIST	EA	1	J8A8
007	22-05-7105 799100-005	27264	HEADER 10-CKT	EA	4	J1A1 J3A3 J5A10 J6A6
008	CL55BJ102MPG 087667-000		CAP ELCTLT 1000UF 50V MIL-C-39003	EA	1	C01 SEE NOTE 1
009	TA1S8-M 500200-020	06383	CLAMP STRAP HOLDER	EA	1	XC01
010	MS3367-4-9 500800-002		STRAP TIEDOWN ADJ 18LB 2. MIL-S-23190	EA	1	XC01
011	MS35221-15 086275-000		SCR PAN HD 4-40 X 3/8 FF-S-92	EA	1	
012	NAS620C4 580110-004		WASHER FL NO 4	EA	2	
013	MS35338-135 580230-004		WASHER LCK NO 4 FF-W-84	EA	1	
014	MS35649-244 581220-440		NUT HEX 4-40	EA	1	
015	22AWG-MILI22129 428600-022		SLEEVING TFL CLEAR MIL-I-22129 EXPLOSION FINISHED	FT	AR	

NOTES: UNLESS OTHERWISE SPECIFIED

1: FACTORY SELECT. NOMINAL VALUE SHOWN.

Figure 5-38. Signal and Power Distribution (Tuner Junction Box) CCA A12 Parts List, Part No. 660187 (Sheet 2 of 2)

Table 5-1. List of Manufacturers' Codes

Code	Manufacturer
00779	AMP Inc. P.O. Box 3608 Harrisburg, PA 17105
01121	Allen-Bradley Company 1301 South Second Street Milwaukee, WI 53204
02114	Ferroxcube Corporation P.O. Box 359 Mt. Marion Road Saugerties, NY 12477
04013	Taurus Corporation 1 Academy Hill P.O. Box 278 Lambertville, NJ 08530
04713	Motorola Inc. Semiconductor Group P.O. Box 2953 5005 East McDowell Road Phoenix, AZ 85062
04967	Fastener Specialty Inc. 3604A W. Pioneer Parkway Arlington, TX 76013
05245	Corcom Inc. 1600 Winchester Road Libertyville, IL 60048-1267
05375	Vari-L Company, Inc. 3833 Monaco Parkway Denver, CO 80207
06383	Panduit Corporation 17301 Ridgeland Tinley Park, IL 60477
07047	The Ross Milton Company 511 Second Street Pike Southampton, PA 18966
09021	Airco Inc. Airco Electronics Bradford, PA
09353	C&K Components Inc. 103 Morse Street Watertown, MA 02172
12855	Trak Microwave Corp. 4726 Eisenhower Blvd. Tampa, FL 33614
13103	Thermalloy Company, Inc. 2021 W. Valley View Lane P.O. Box 810839 Dallas, TX 75381
14674	Corning Glass Works Houghton Park Corning, NY 14830
15542	Mini-Circuits Laboratory Div. of Scientific Components Corporation 2625 East 14th Street Brooklyn, NY 11235
16179	Omni Spectra Inc. 140 Fourth Avenue Waltham, MA 02154
17217	Gore, W.L. and Associates Inc. 555 Paper Mill Road P.O. Box 9329 Newark, DE 19714
18203	Engelman Microwave Div. Div. of KDI Electronics Inc. 60 South Jefferson Road Whippany, NJ 07981
18565	Chomerics Incorporated 77 Dragon Court Woburn, MA 01801

Table 5-1. List of Manufacturers' Codes - Continued

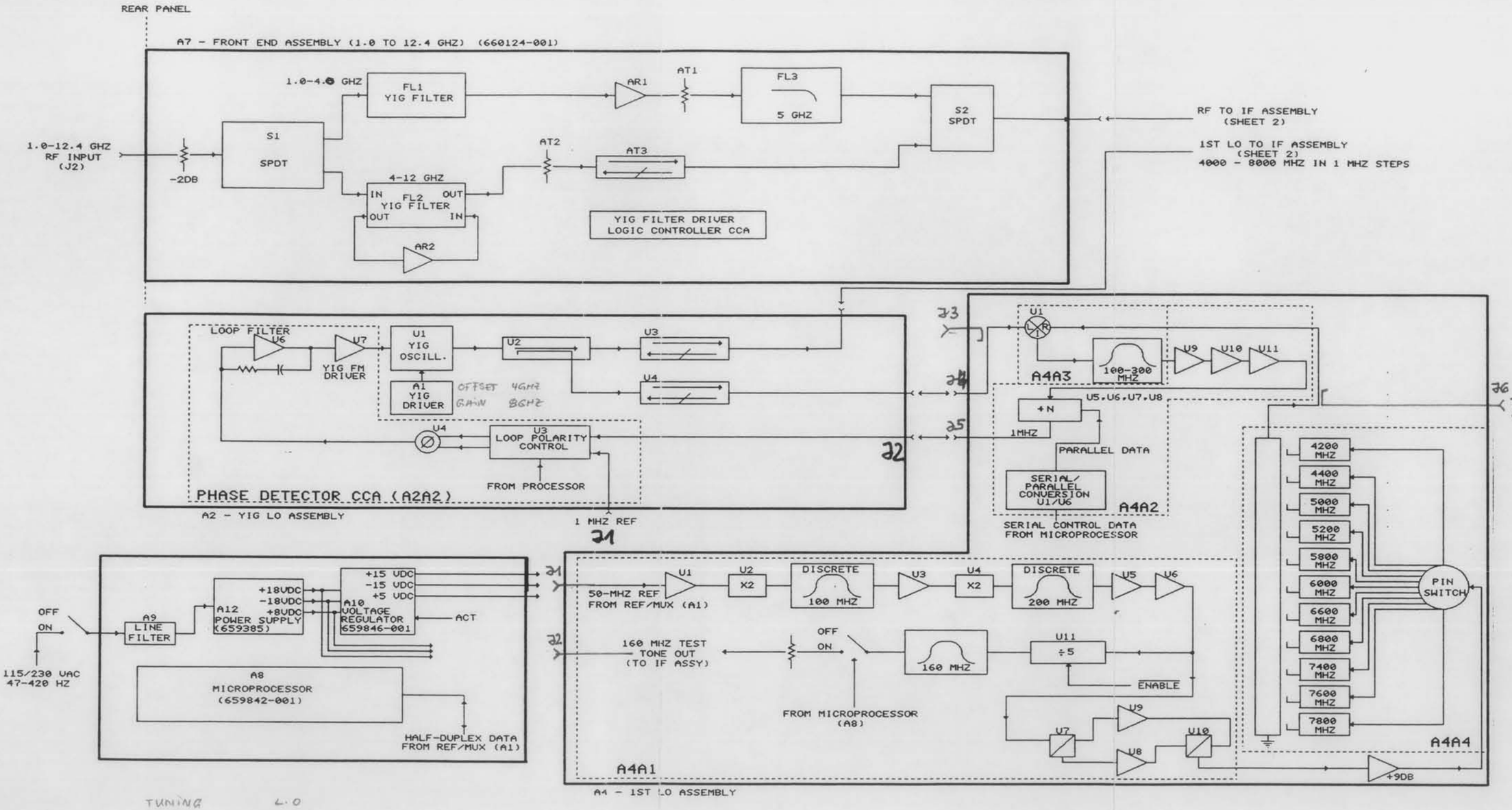
Code	Manufacturer
21912	Anzac Electronics Div. of Adams-Russell Co. 39 Green Street Waltham, MA 92154
22526	Du Pont E.I. de Nemours and Co., Inc. Photo Products Dept. Berg Electronics Div. Route 83 New Cumberland, PA 17070
23936	William J. Purdy Company Pamotor Division 770 Airport Boulevard Burlingame, CA 94010-1927
24539	Avantek, Inc. 3175 Bowers Avenue Santa Clara, CA 95051
24602	EMC Technology Inc. 1971 Old Cuthbert Road Cherry Hill, NJ 08034-1417
27264	Molex Products Company 5224 Katrine Avenue Donners Grove, IL 60515
27956	Relcom Mountain View, CA
28480	Hewlett-Packard Company 1501 Page Mill Road Palo Alto, CA 94304
29990	American Technical Ceramics One Norden Lane Huntington Station, NY 11746-2102
30161	Aavid Engineering Inc. One Kool Path P.O. Box 400 Laconia, NH 03247
30990	Connecting Devices Inc. 125 Lomita Street El Segundo, CA 90245
31433	Union Carbide Corporation Materials System Division Component Department Highway 276 SE Greenville, SC 29606
32559	Bivar Incorporated 4 Thomas Street Irvine, CA 92718
32997	Bourns Inc. Trimpot Products Division 1200 Columbia Avenue Riverside, CA 92507
33095	Spectrum Control Inc. 152 East Main Street Fairview, PA 16415
33592	MITEQ Incorporated 100 Ricefield Lane Hauppauge, NY 11788
39428	McMaster-Carr Supply Co. P.O. Box 4355 Chicago, IL 60680-4355
50140	K and L Microwave Inc. 409 Cole Circle Salesbury, MD 21801
50667	Dynatech/U-Z Inc. 589 Venice Boulevard Venice, CA 90291
51642	Centre Engineering, Inc. 2820 East College Avenue State College, PA 16801-7515

Table 5-1. List of Manufacturers' Codes - Continued

Code	Manufacturer
56289	Sprague Electric Company North Adams, MA 01247
56769	Visual Communications Co. 8118 West 83rd Street Playa Del Rey, CA
59660	Tusonix Inc. 7741 N. Business Park Dr. P.O. Box 37144 Tucson, AZ 85740-7144
70192	GAP Instrument Corp. Gorn Division 110 Marcus Boulevard Hauppauge Long Island, NY 11787
71279	Cambridge Thermionic Corp. 445 Concord Avenue Cambridge, MA 02138
71400	McGraw-Edison Company Bussman Mfg. Division 502 Earth City Plaza Earth City, MO 63045
71984	Dow Corning Corporation 3901 S. Saginaw Road Midland, MI 48640
72982	Erie Technological Products Inc. 644 West 12th Street Erie, PA 16512
73138	Beckman Instruments Inc. Helipot Division 2000 Harbor Boulevard Fullerton, CA 92634
73445	Amperex Electronic Corp. 230 Duffy Avenue Hicksville, NY 11802
74858	Indium Corp. of America 1676-80 Lincoln Avenue Utica, NY 13502
75042	TRW Electronics Components IRC Philadelphia Division 401 North Broad Street Philadelphia, PA
75378	CTS Knights Inc. 400 Reimann Avenue Sandwich, IL 60548-1846
75915	Littelfuse Inc. 800 East Northwest Highway Des Plaines, IL 60016
80131	Electronic Industries Assoc. 2001 Eye Northwest Street Washington, D.C. 20006
81350	Joint Army-Navy specifica- tions promulgated by Standardization Division, Directorate of Logistic Services DSA
82389	Switchcraft Inc. 5555 North Elston Avenue Chicago, IL 60630
83330	H.H. Smith Inc. 812 Snediker Avenue Brooklyn, NY 11207
91293	Johnson Manufacturing Co. P.O. Box 329 Boonton, NJ 07005
91506	Augat Inc. P.O. Box 779 633 Perry Avenue Attleboro, MA 02703

Table 5-1. List of Manufacturers' Codes - Continued

Code	Manufacturer
91637	Dale Electronics P.O. Box 609 Columbus, NE
93306	Uniform Tubes Inc. 200 West Seventh Avenue Collegeville, PA 19426
96341	Microwave Associates Inc. Northwest Industrial Park South Avenue Burlington, MA 01803
98291	Sealectro Corporation 225 Hoyt Mamaroneck, NY 10544
98978	International Electronic Research Corporation 135 W. Magnolia Blvd. Burbank, CA 91502
99800	American Precision Industries Inc. Delevan Division 270 Quaker Road East Aurora, NY 14052-2114



U1 YIG LO :

TUNING	L.O
1.000	5.409
2.000	6.409
2.999	7.408
3.000	4.965
5.000	6.965
5.999	7.964
6.000	4.036 → OFFSET R10
8.000	6.036
8.999	7.035
9.000	4.592
12.000	7.592
12.400	7.992 → GAIN R15

87.B.9001/1

Figure 6-1. Tuner Functional Block Diagram (Sheet 1 of 2)

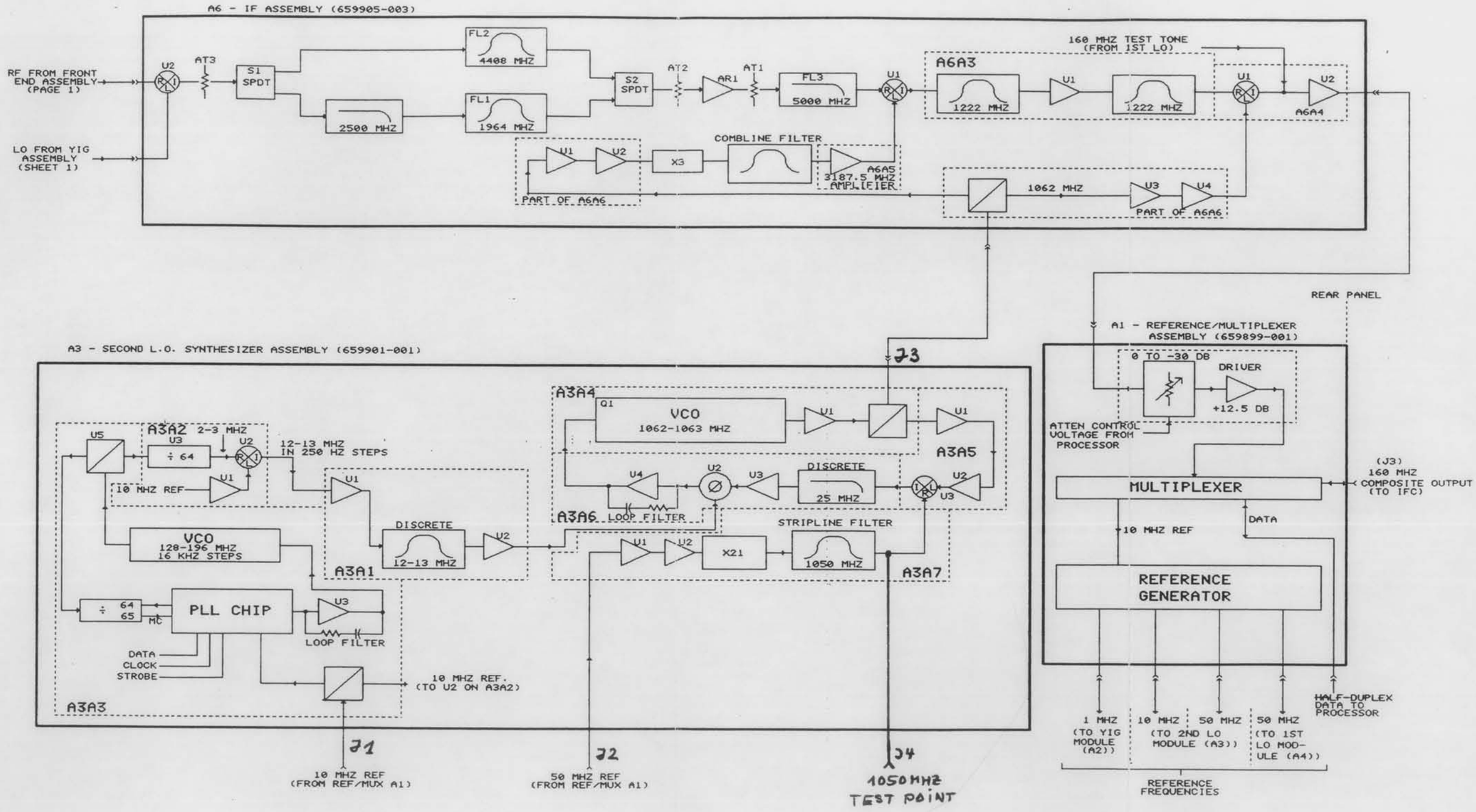


Figure 6-1. Tuner Functional Block Diagram (Sheet 2 of 2)

87.B.9001/2

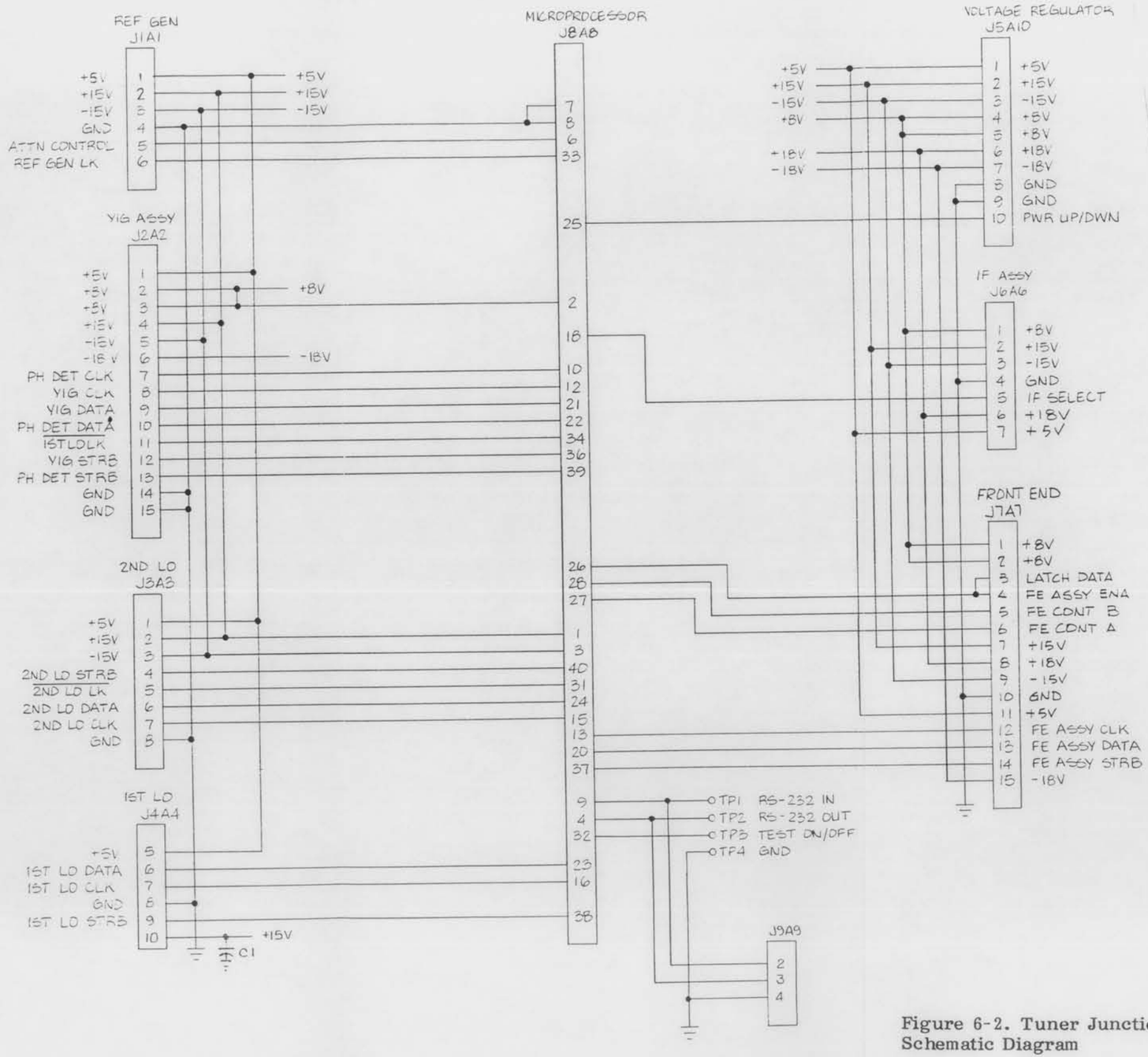
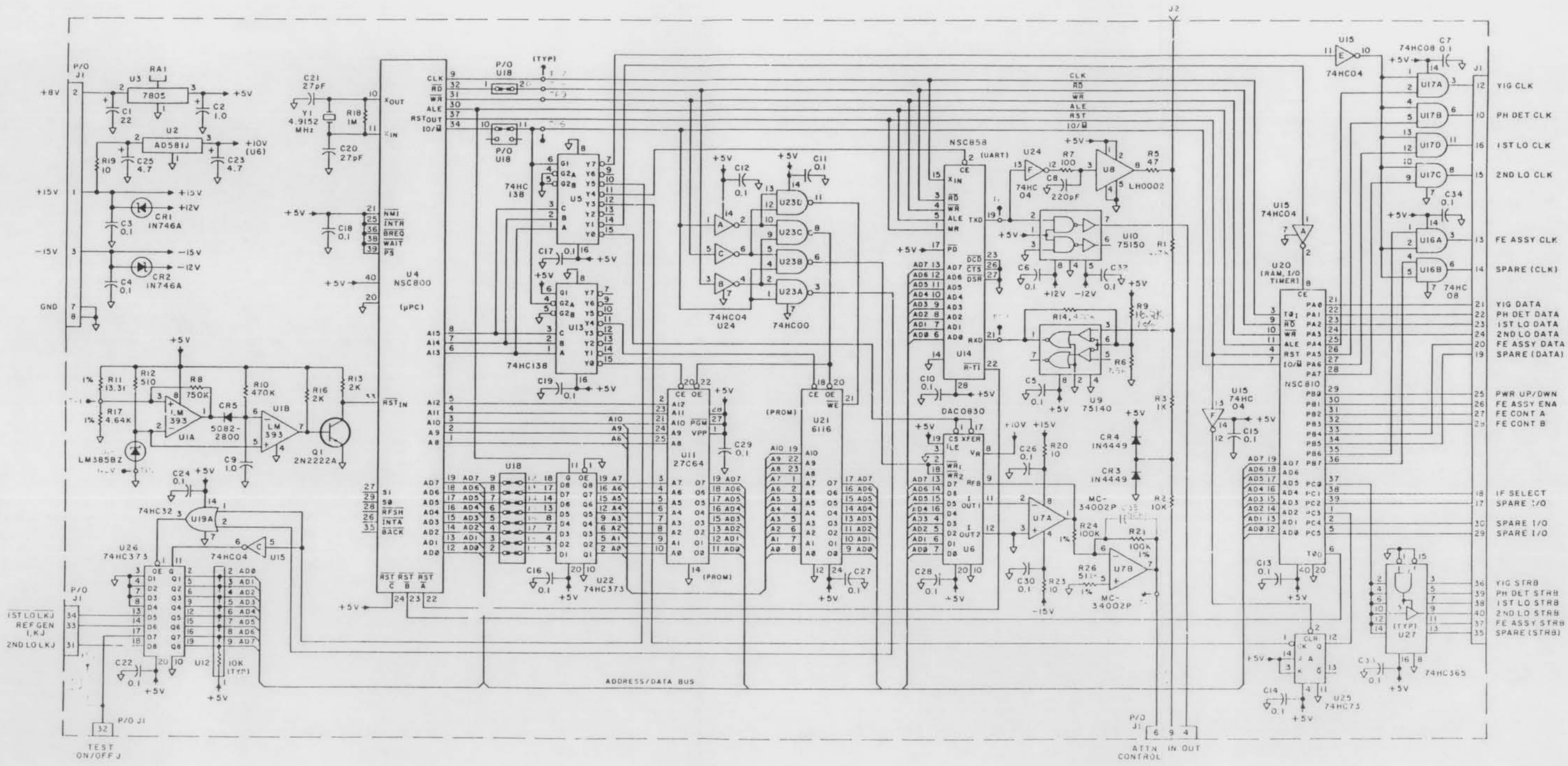


Figure 6-2. Tuner Junction Board A12 Schematic Diagram

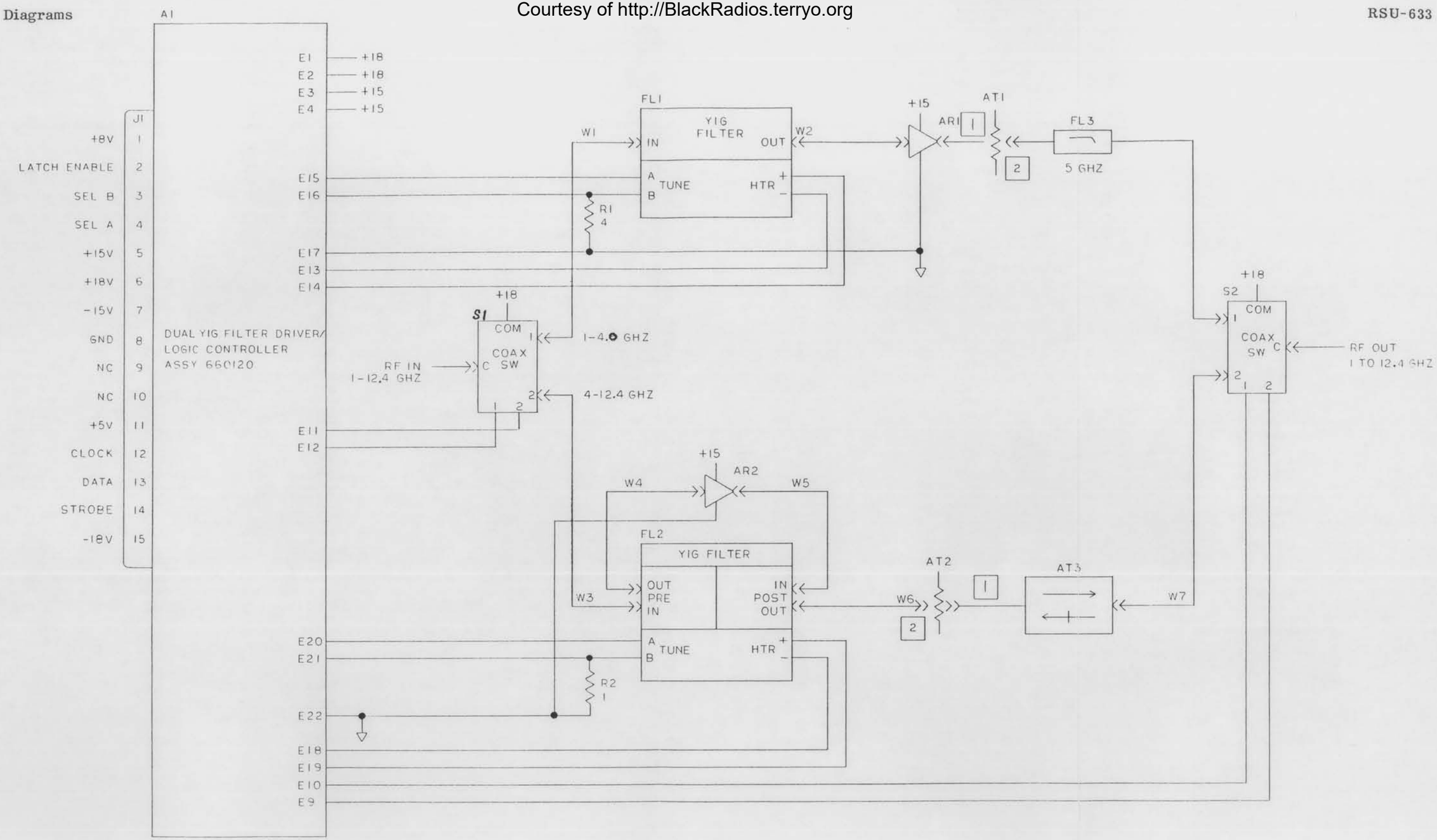
659979C



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W
   b) CAPACITANCE IS IN μF

Figure 6-3. Microprocessor A8 Schematic Diagram

659845B



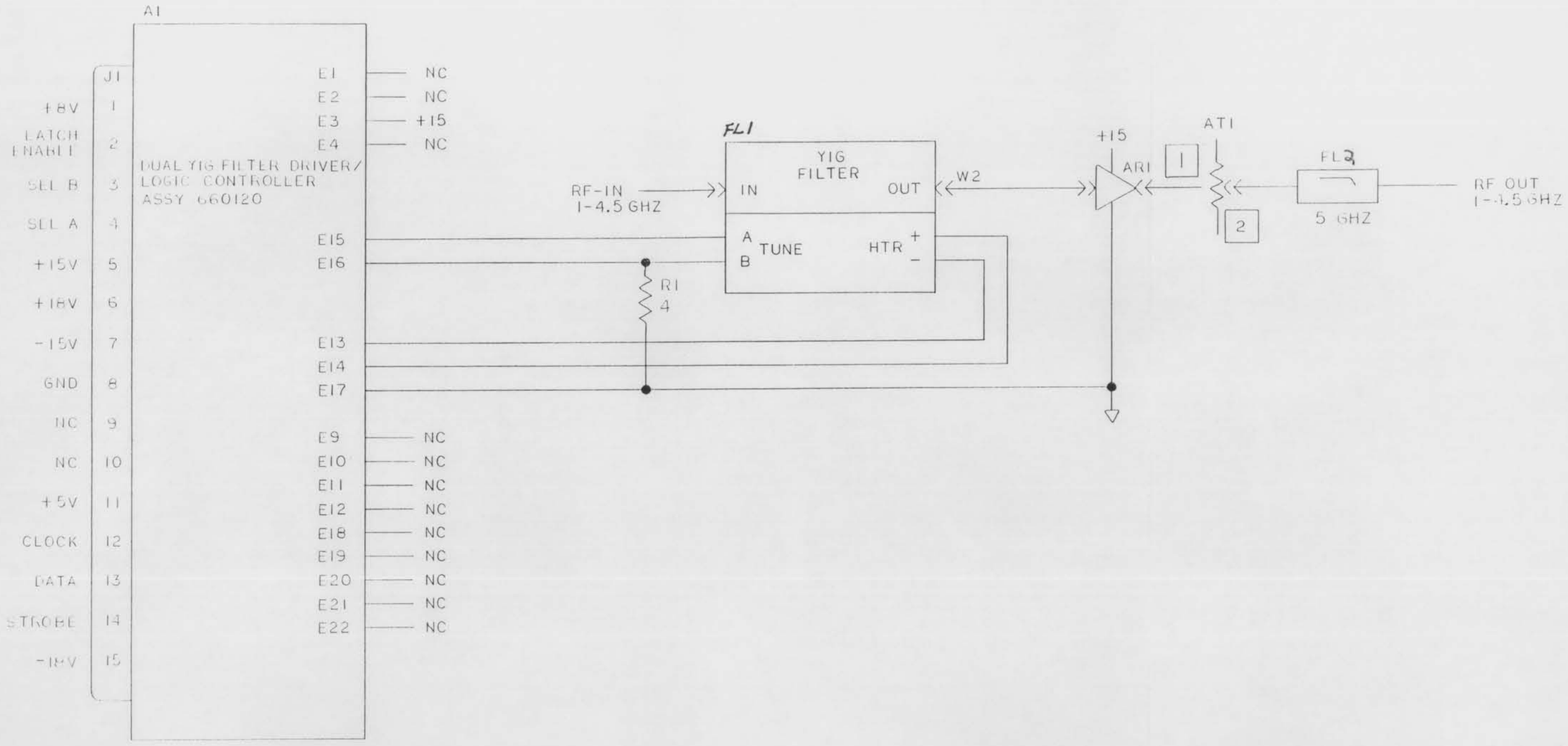
3. ALL RESISTANCE VALUES IN OHMS, 1%, 5W

[2] FACTORY SELECT

[1] DEVICES MOUNTED DIRECTLY TO PADS (NO CABLE)

660130

Figure 6-4. 1.0 to 12.4 GHz Front End Assembly A7, Interconnection Diagram



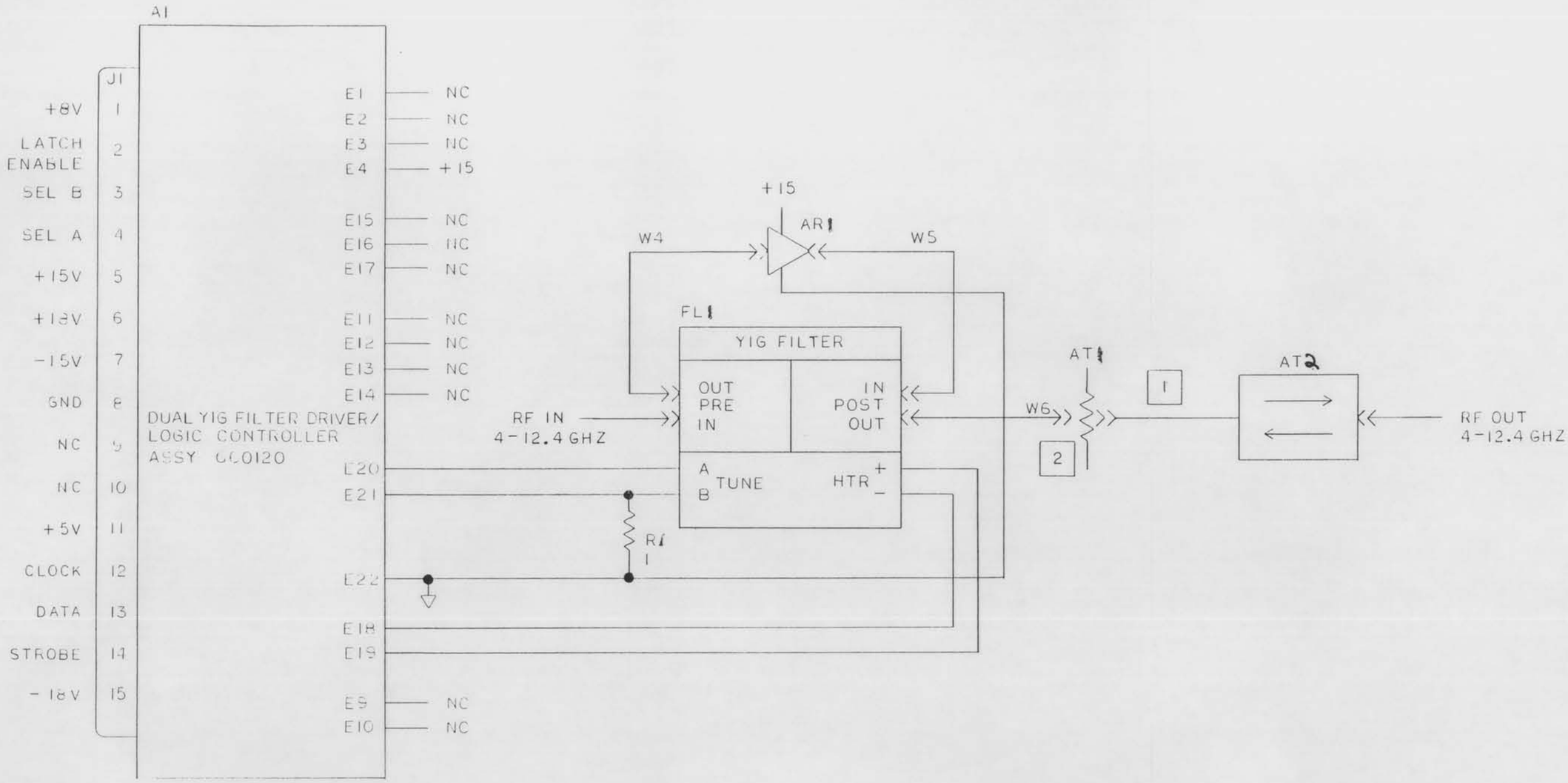
3. ALL RESISTANCE VALUES IN OHMS, 1 %, 5W

[2] FACTORY SELECT

[1] DEVICES MOUNTED DIRECTLY TO PADS (NO CABLE)

660341

Figure 6-5. 1.0 to 4.5 GHz Front End Assembly A7, Interconnection Diagram



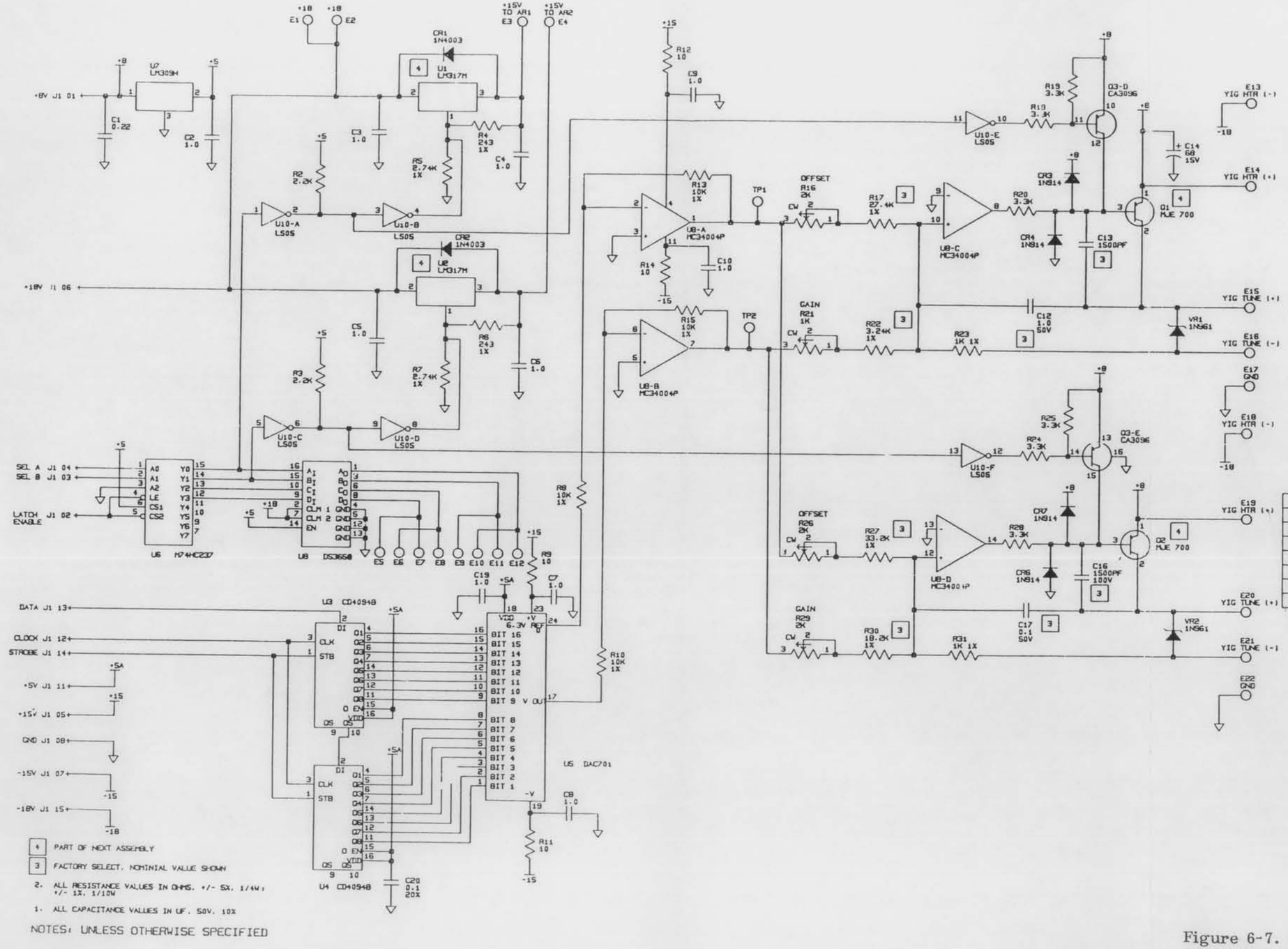
3. ALL RESISTANCE VALUES IN OHMS, 1 %, 5W

[2] FACTORY SELECT

[1] DEVICES MOUNTED DIRECTLY TO PADS (NO CABLE)

660381

Figure 6-6. 4.0 to 12.4 GHz Front End Assembly A7, Interconnection Diagram

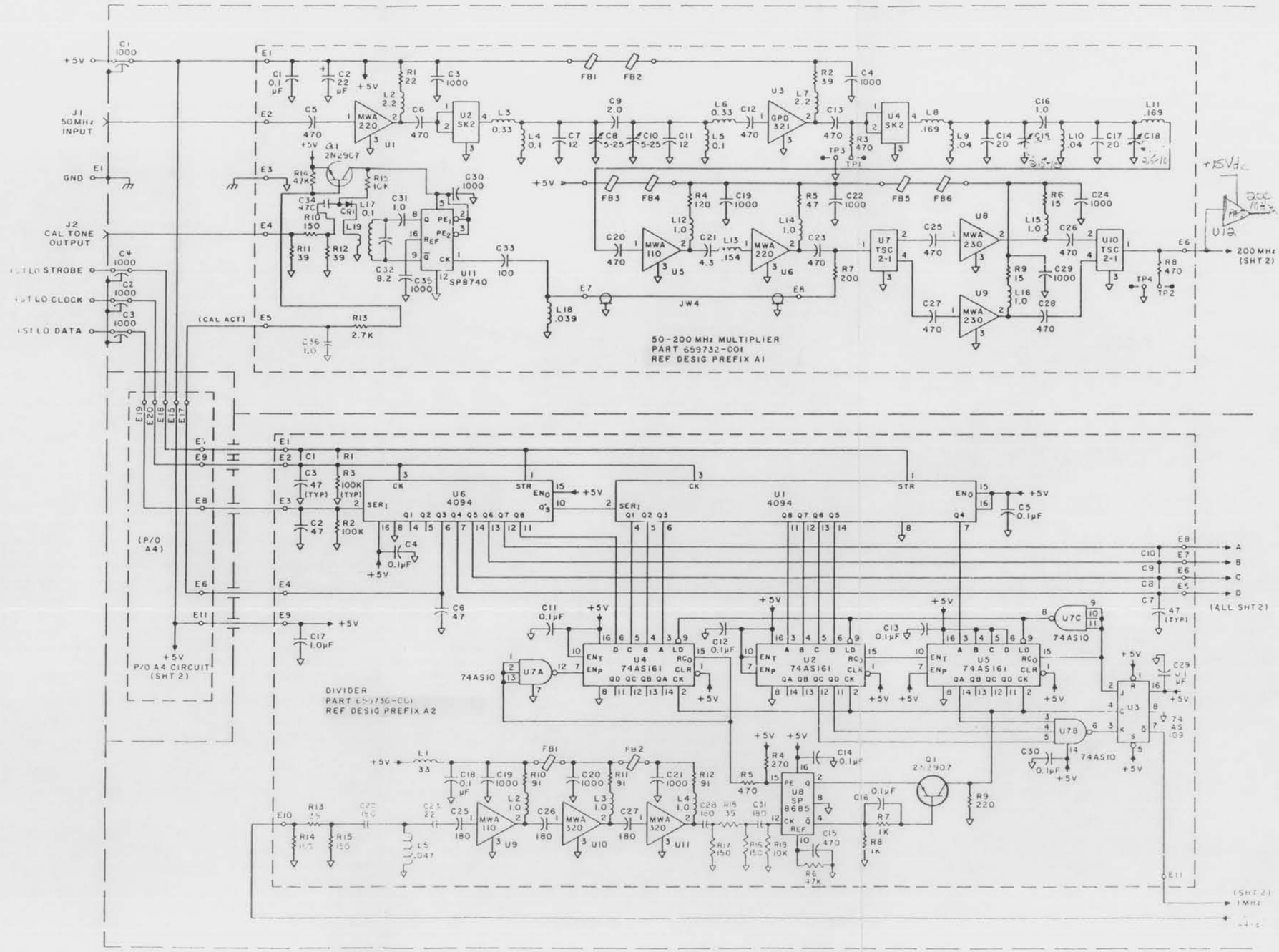


COMPONENT REF DESIG		
FIRST	LAST	DELETED
C1	C21	
CR1	CR6	C11, 15, 18, 21
E1	E22	
R2	R31	R1
TP1	TP2	
U1	U10	
VR1	VR2	
Q1	Q3	

INTEGRATED CIRCUIT IDENTIFICATION TABLE						
REF DES	TYPE	+15V	+5V	GND	+5VA	-15V
U6	74HC237		16	8		
U8	MC34004	4				11
U9	DS3658		11	4,5,12,13		
U10	LS05		14	7		
U3, U4	CD4094			8	16	
U5	DAC701	23		20	18	19

660123A

Figure 6-7. Dual YIG Filter Driver/Logic Controller A7A1, Interconnection Diagram



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/8 W.
   b) CAPACITANCE IS IN pF.
   c) INDUCTANCE IS IN µH.
   d) DIODES ARE 1Gxxx-3xxx.

Figure 6-8. First LO Synthesizer A4 Schematic Diagram (Sheet 1 of 2)

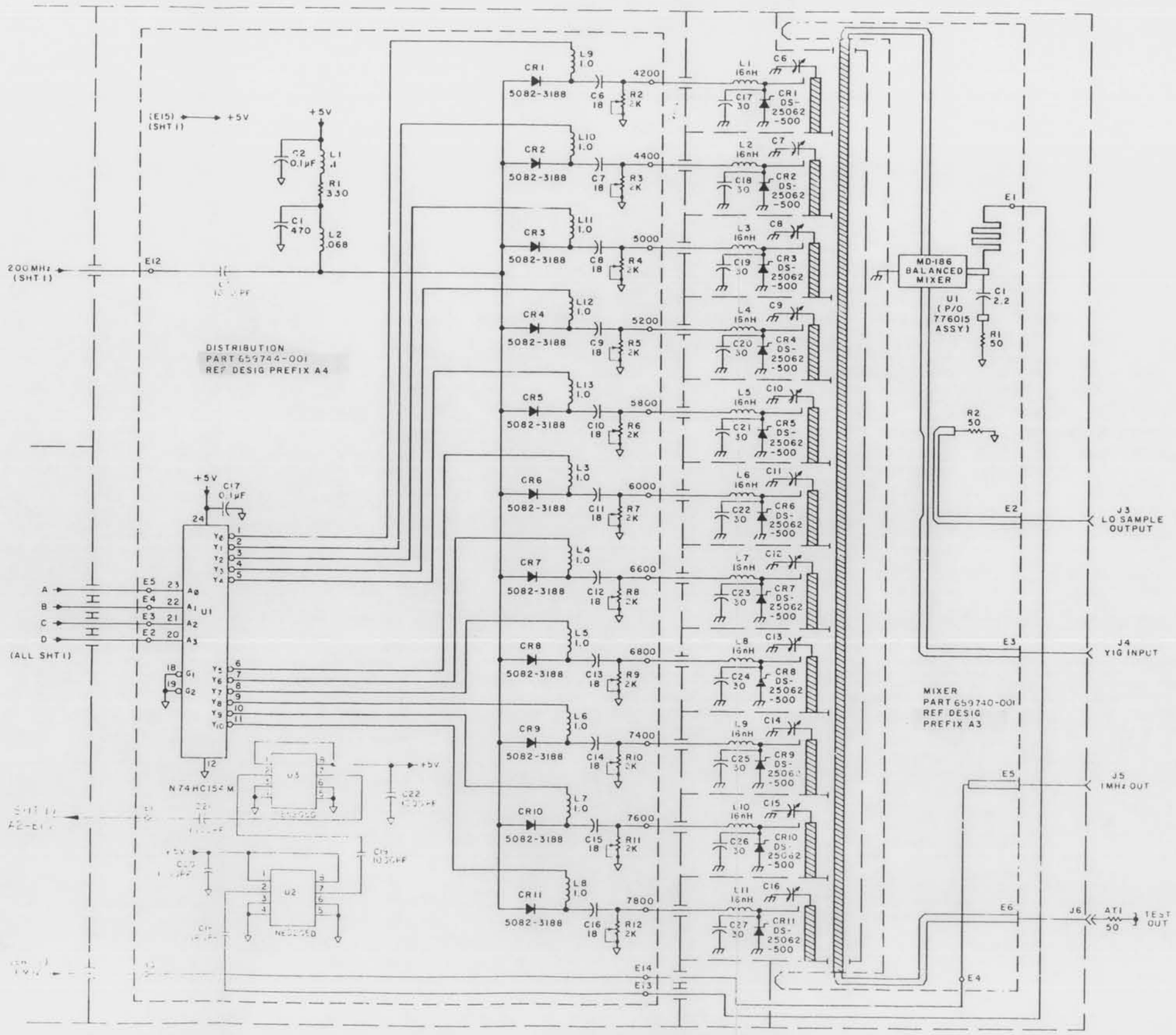
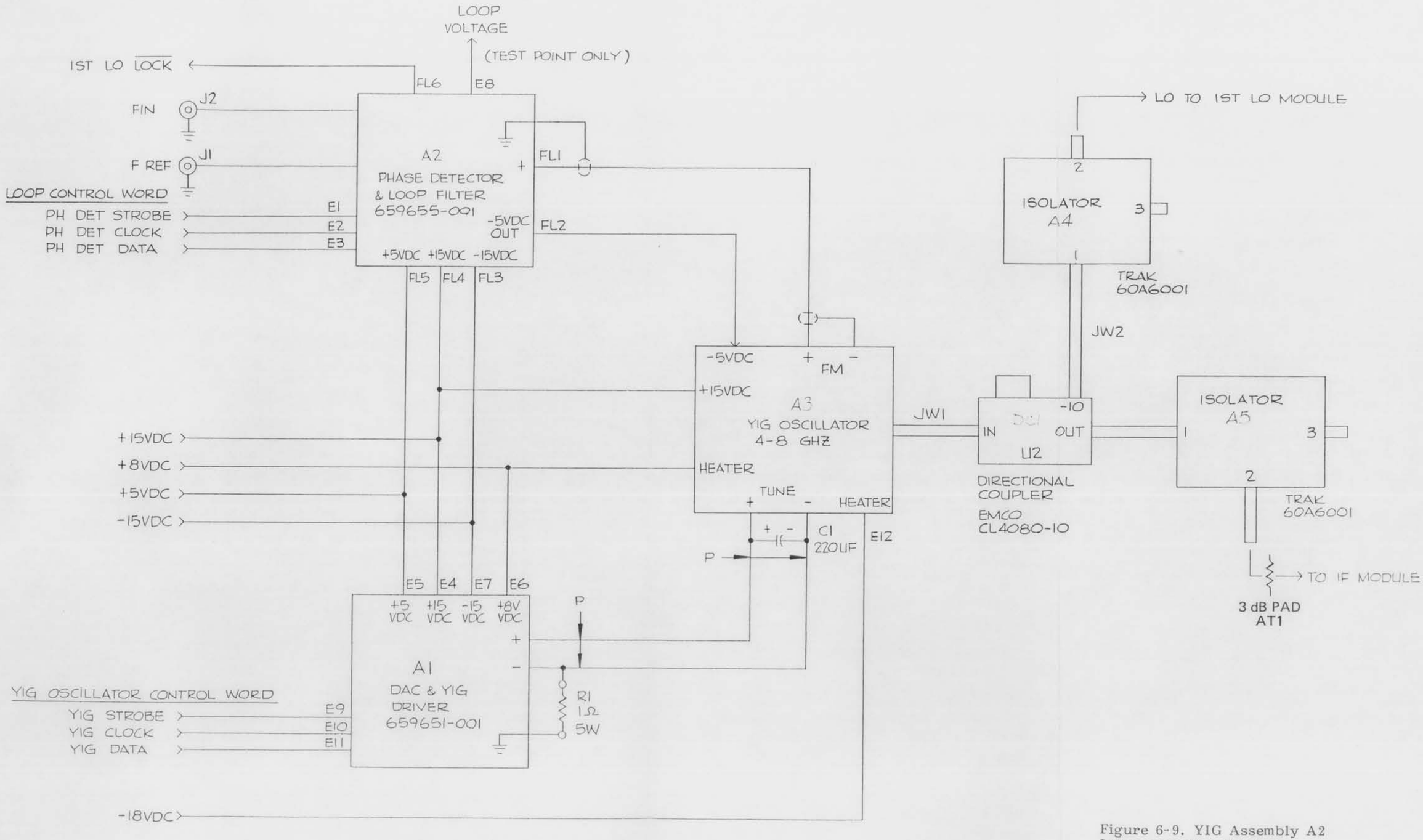


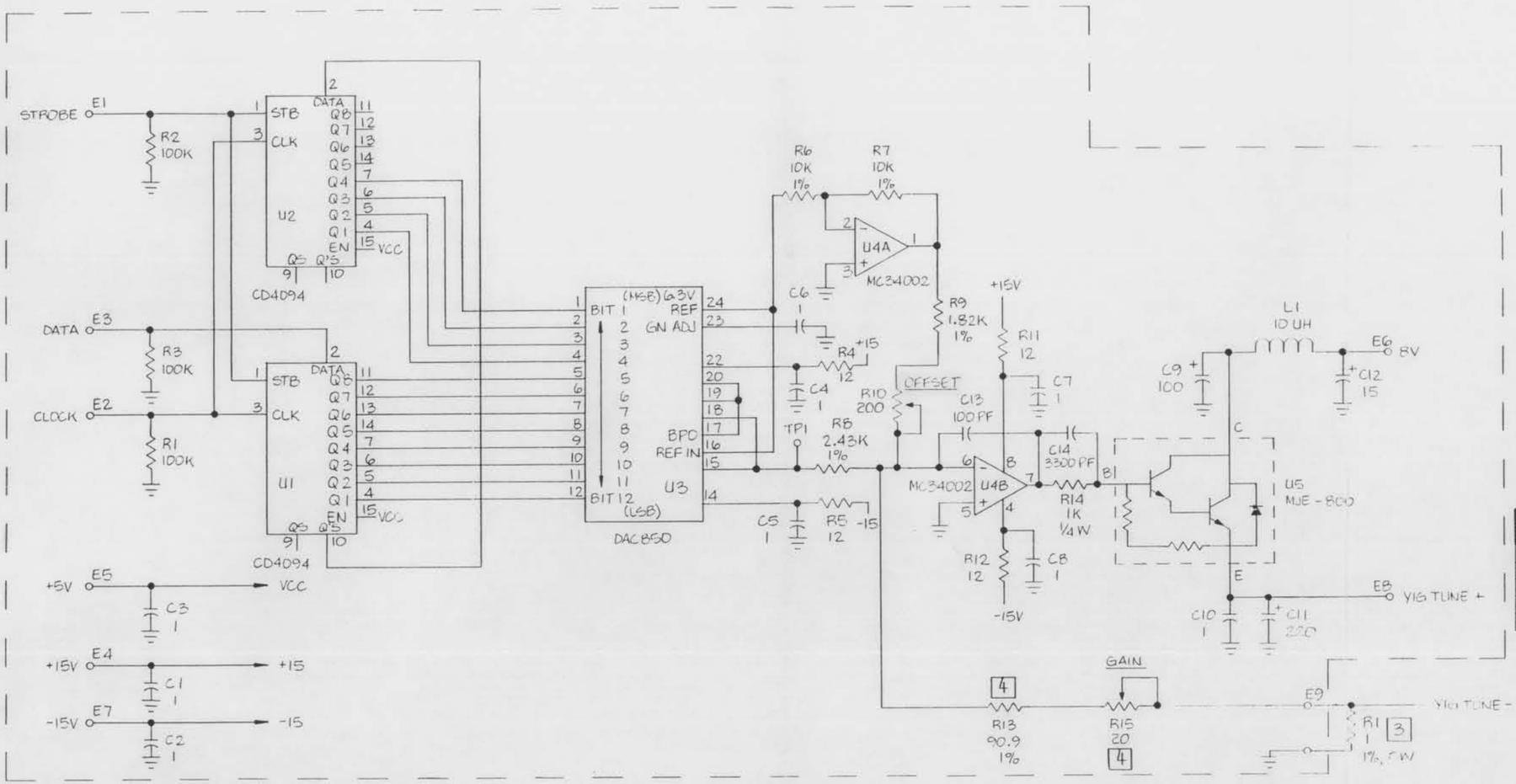
Figure 6-8. First LO Synthesizer A4 Schematic Diagram (Sheet 2 of 2)

659858D/2



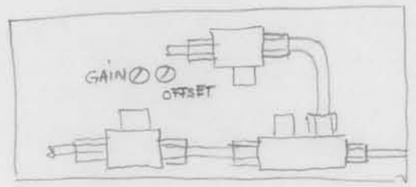
660567

Figure 6-9. YIG Assembly A2 Interconnection Diagram



COMPONENT REF. DESIGN.		
FIRST	LAST	DELETED
C1	C14	
E1	E10	
L1	L1	
R1	R15	
U1	U5	

INTEGRATED CIRCUIT IDENTIFICATION TABLE						
REF. DESIG.	TYPE	+15V	VCC	GND	-15V	CKT
U1, U2	CD4094	—	16	8	—	1
U3	DAC850	—	13	21	—	1
U4	MC34002	—	—	—	—	2
U5	MJE-800	—	—	—	—	1



4 FACTORY SELECT

3 PART OF NEXT ASSY

2. ALL RESISTANCE VALUES IN OHMS, ± 5 %, 1/8 W, 1% ARE 1/10 W

1. ALL CAPACITANCE VALUES IN UF

NOTES: UNLESS OTHERWISE SPECIFIED

659654C

Figure 6-10. DAC and YIG Driver A2A1 Schematic Diagram

* R23/24 6.2K
* R21/22 750Ω } SN 001

INTEGRATED CIRCUIT IDENTIFICATION TABLE						
REF DESIG	TYPE	+15V	VCC	GND	-15V	+5VA
U1	CD4094B			8		16
U2	74LS08			7		14
U3	74LS157			8		16
U4	MC4044		14	7		
U5	7905			1		
U6	LT0007					
U7	LH0002CN					

1 MHZ F_{REF} J1

1 MHZ F_{IN} J9

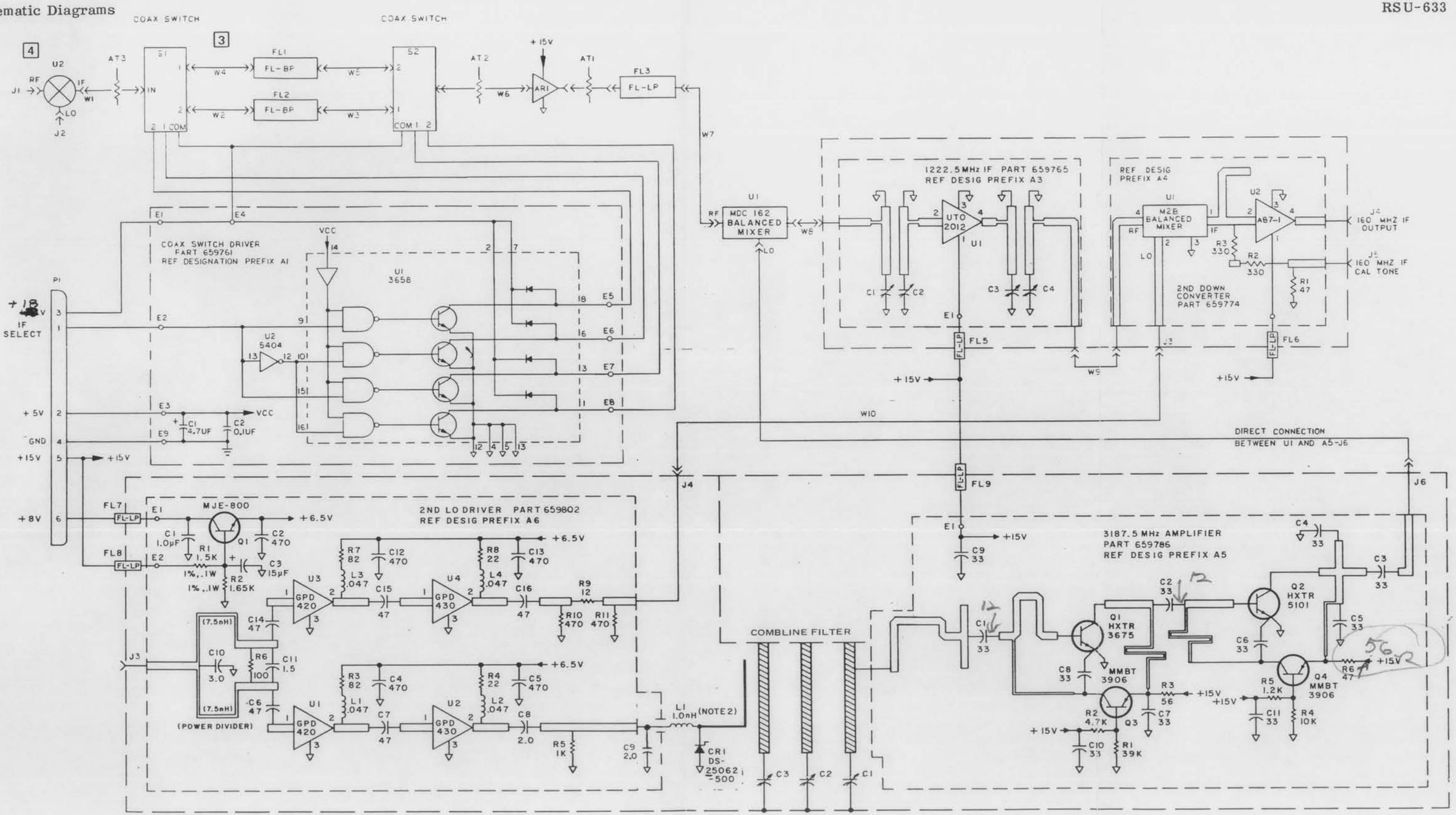
A4A2

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCE VALUES IN OHMS, +/- 5%, 1/8W
2. ALL CAPACITANCE VALUES IN UF, 100V

659658A

Figure 6-11. Phase Detector and Loop Filter A2A2, Schematic Diagram



3 -003 VERSION HAS AT3 AND FL4 CONNECTED CONNECTED BETWEEN S1-1 AND INPUT TO FL1

4 -002 VERSION HAS U2 CONNECTED SO THAT RF IS CONNECTED TO AT3 AND IF IS CABLED RF INPUT FROM MODULE A7

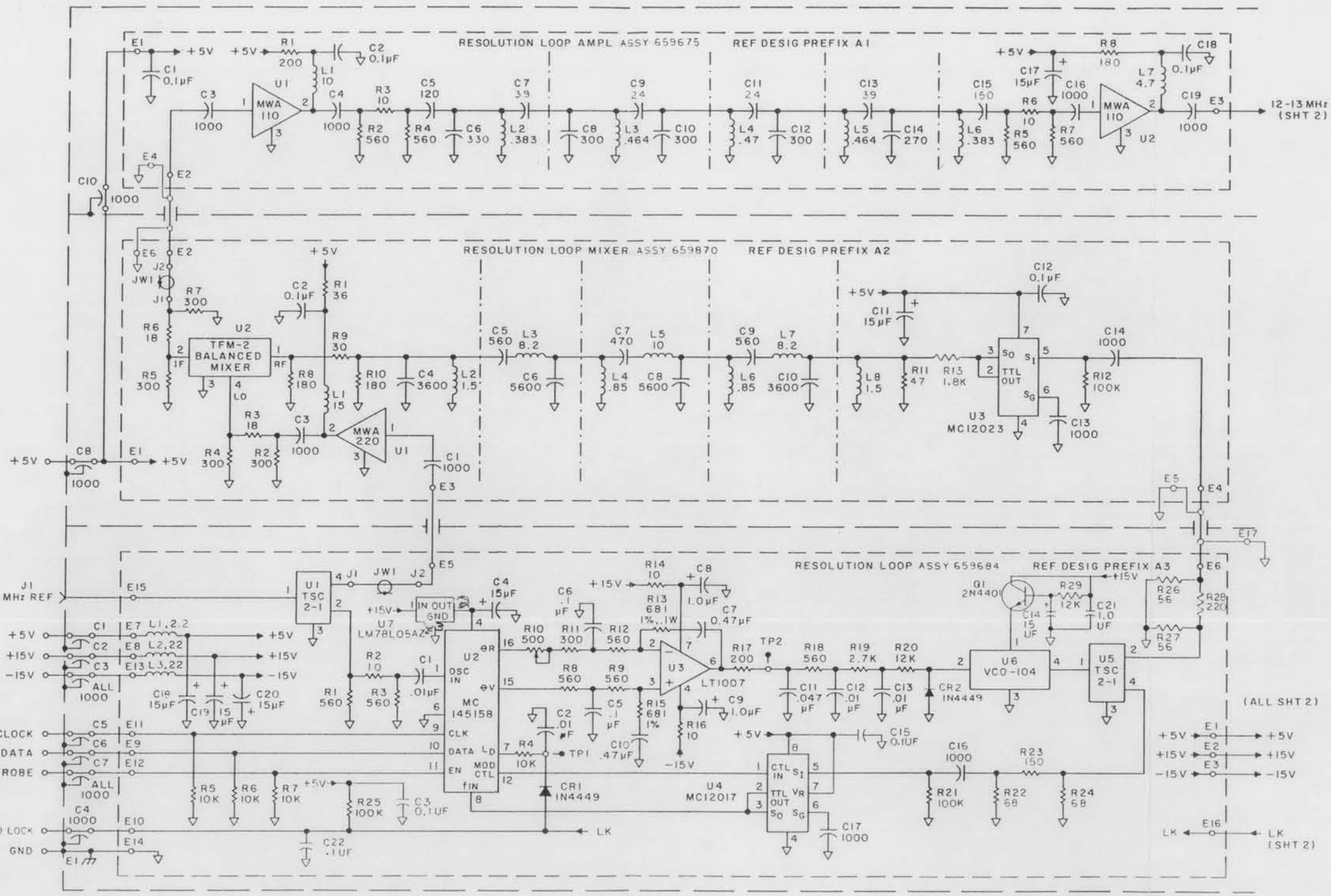
NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/8W.
   b) CAPACITANCE IS IN pF.
   c) INDUCTANCE IS IN μH.
2. L1, CR1 ARE PART OF ASSY 659905

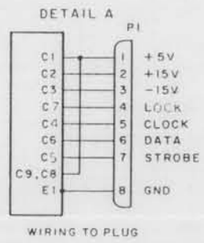
INTEGRATED CIRCUIT IDENTIFICATION TABLE						
REF. DESIGN.	TYPE	+15V	VCC	GND	-15V	CKT
A1-U1	3658	—	11	12	—	
A1-U2	5404	—	14	7	—	

659906B

Figure 6-12. IF Assembly A6 Interconnect Diagram

J.P. COLE 3091
JOHN TRACKI 3625





5. FACTORY SELECT

4. FOR WIRING TO PLUG (P1), SEE DETAIL A

3. ALL INDUCTANCE VALUES IN UH

2. ALL CAPACITANCE VALUES IN PF

1. ALL RESISTANCE VALUES IN OHMS, ± 5%, 1/4W

65967B/1

Figure 6-13. Second LO Synthesizer/ Resolution Loop 10 MHz Mixer A3 Schematic Diagram (Sheet 1 of 2)

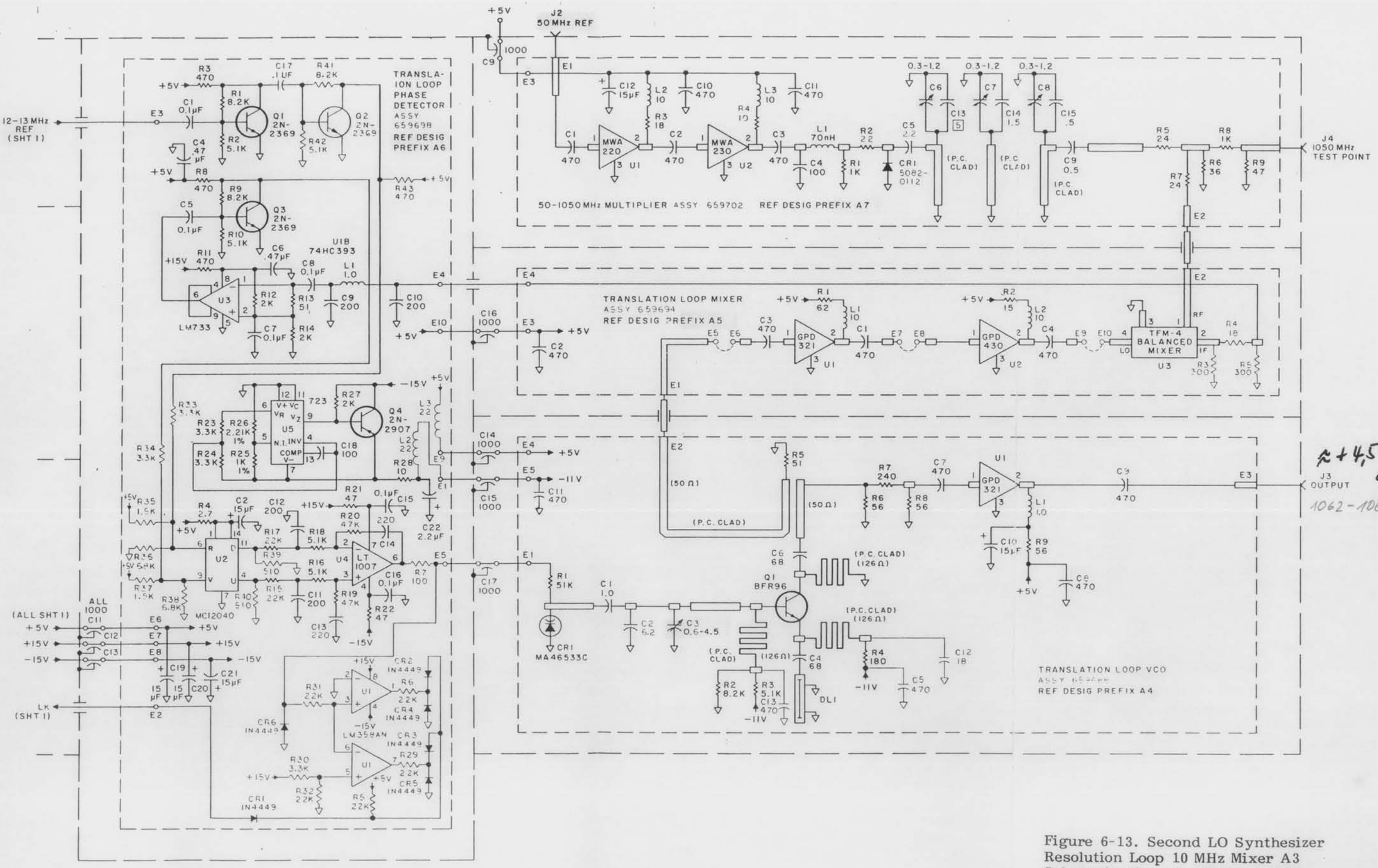
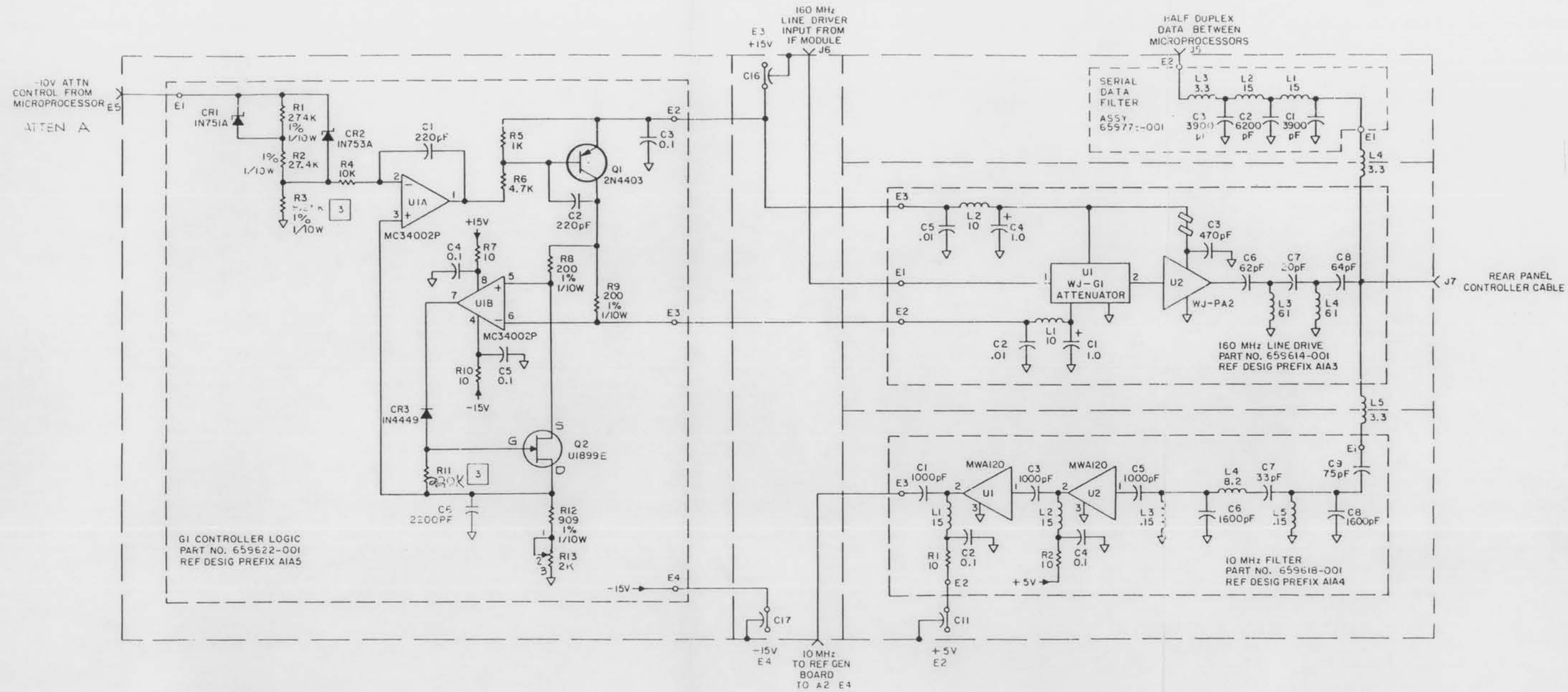


Figure 6-13. Second LO Synthesizer Resolution Loop 10 MHz Mixer A3 Schematic Diagram (Sheet 2 of 2)

65967B/2



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) CAPACITANCE IS IN μF.
   b) INDUCTANCE IS IN μH.
   c) RESISTANCE IS IN OHMS, ±5%, 1/4W.

[2] SHIELDED 50 OHM CABLE (SHEET 2)

[3] FACTORY SELECT. NOMINAL VALUE SHOWN

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Figure 6-14. Reference Generator/ Multiplexer Assembly A1 Schematic Diagram (Sheet 1 of 2)

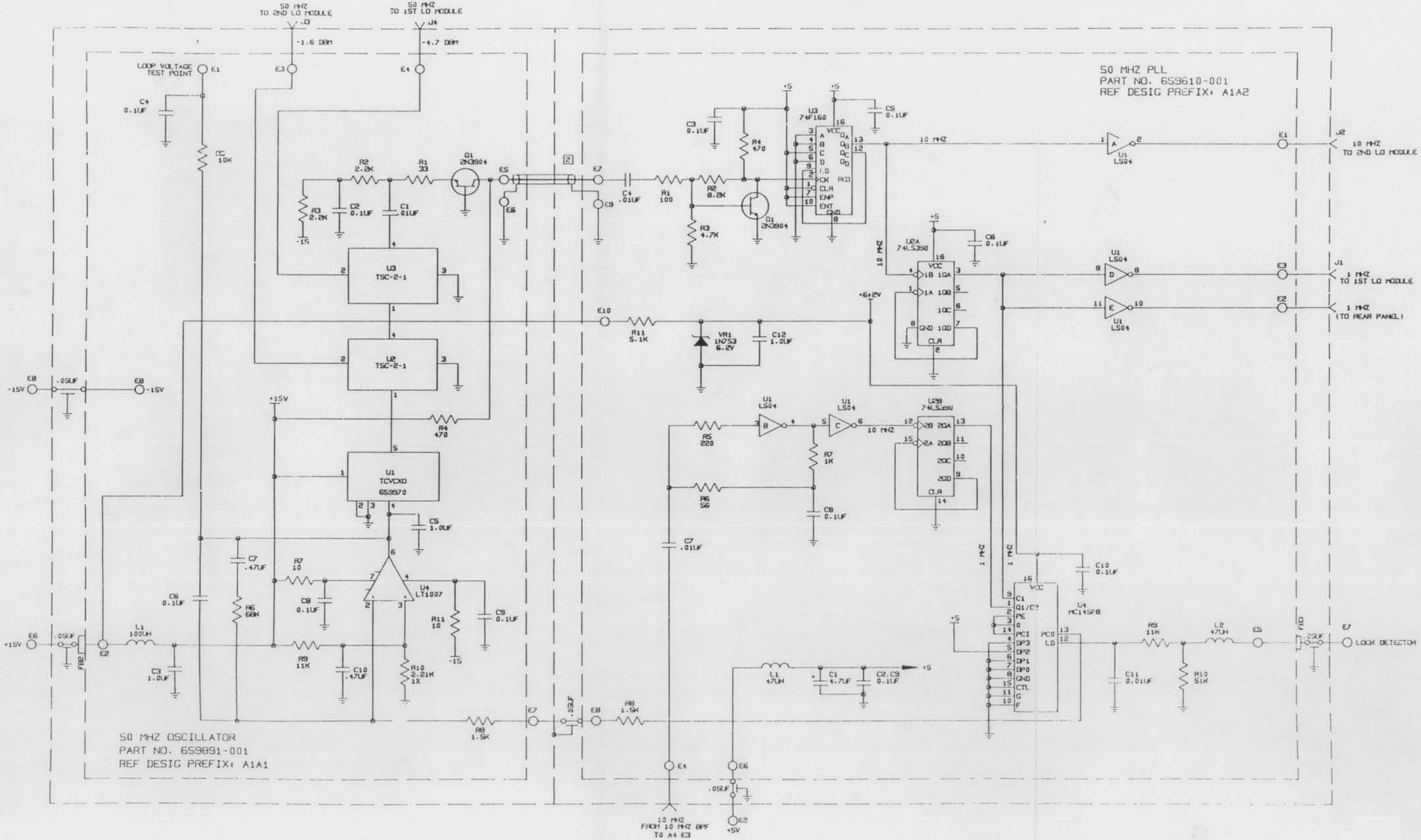

Figure 6-14. Reference Generator/ Multiplexer Assembly A1 Schematic Diagram (Sheet 2 of 2)

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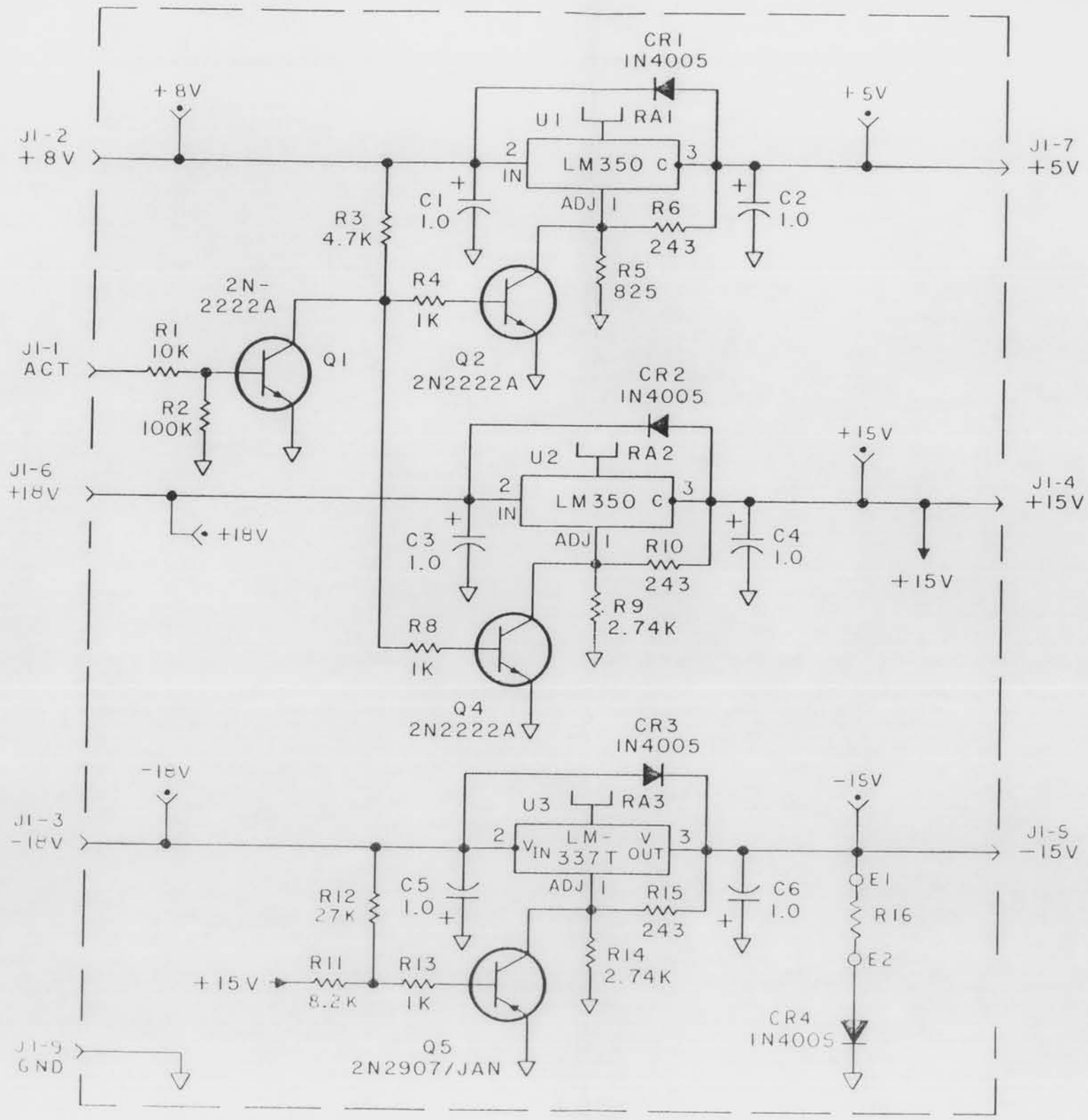
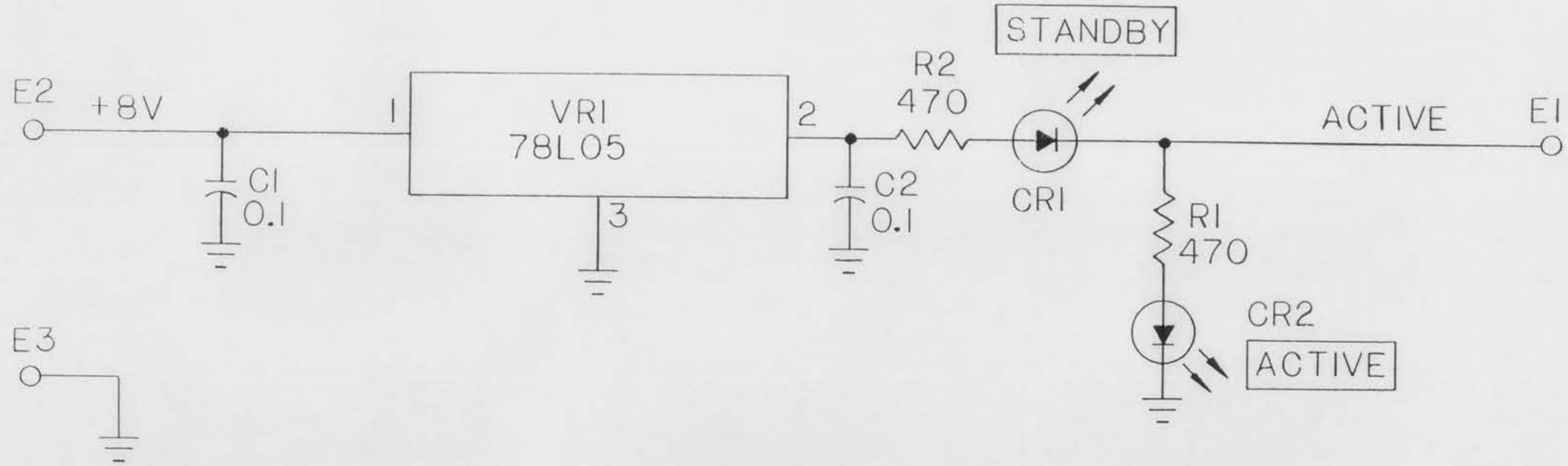


NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
   b) CAPACITANCE IS IN μF.

659849A

Figure 6-15. Voltage Regulator A10 Schematic Diagram

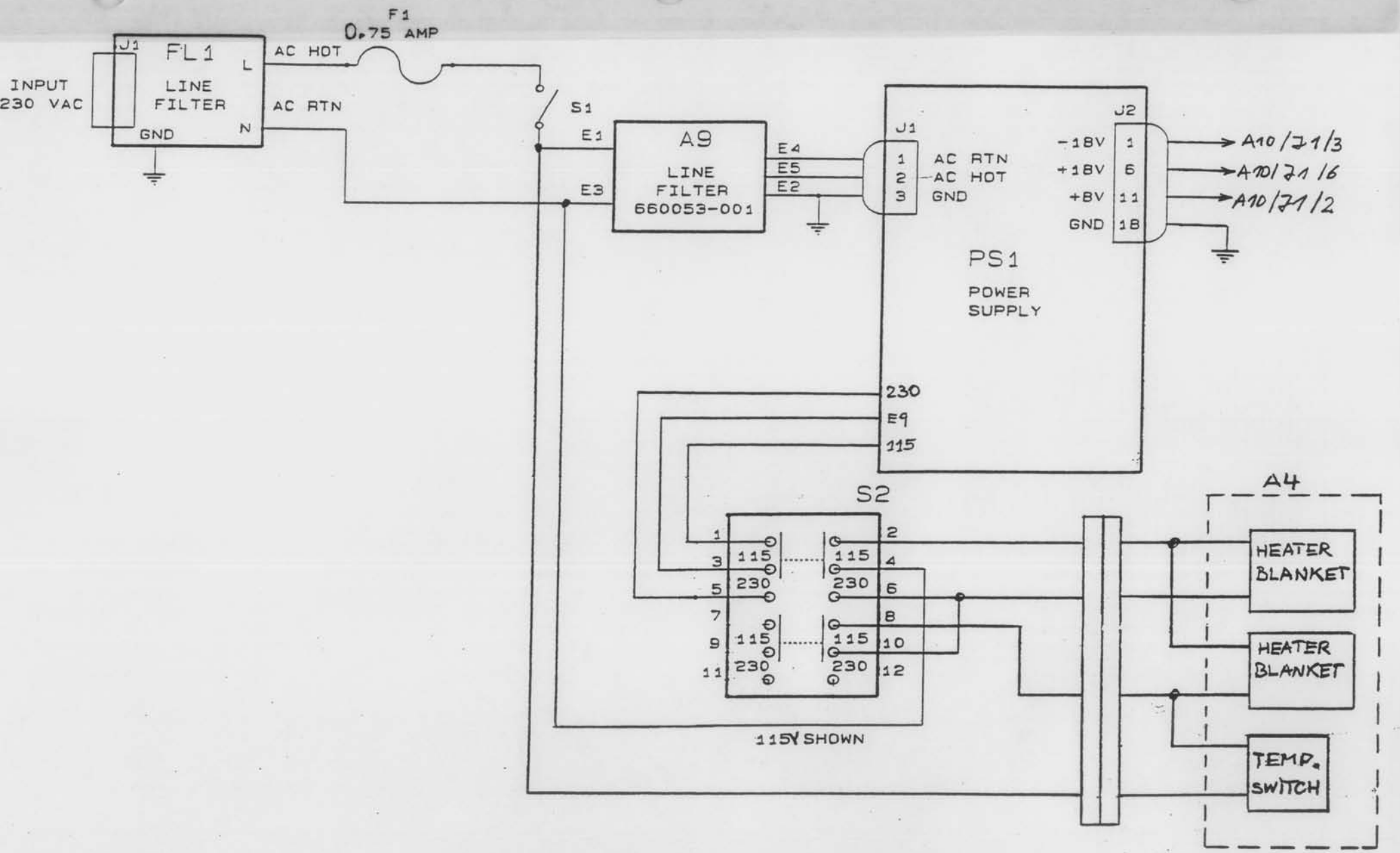


2 ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%.

1. ALL CAPACITOR VALUES ARE IN UF, 50V, 20%.

659853

Figure 6-16. Front Panel LED Assembly A11, Schematic Diagram



TUNER INTERCONNECT DIAGRAM
HEATER BLANKET VERSION

WFS 18/1/91

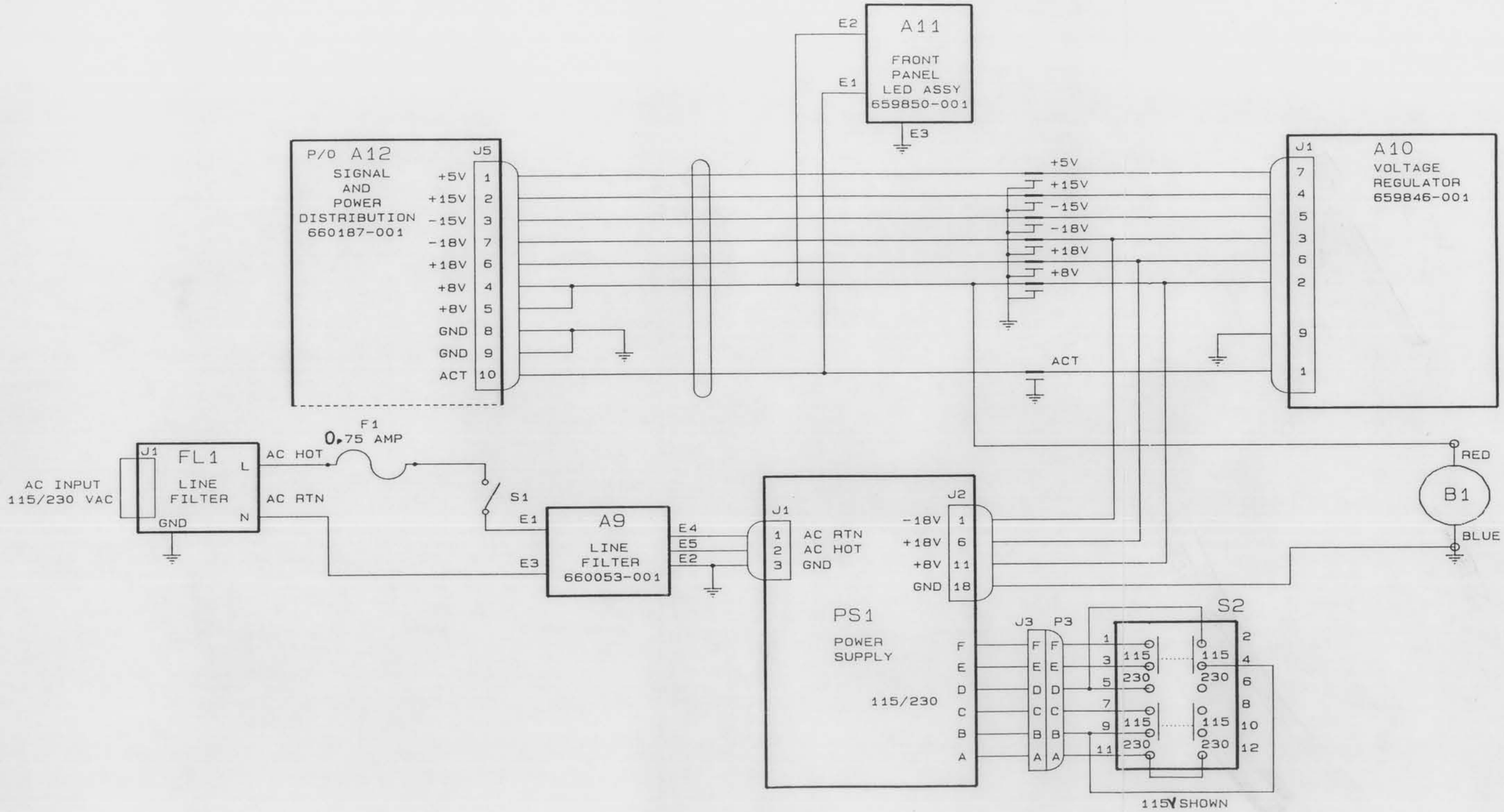


Figure 6-17. Tuner Interconnect Diagram (Sheet 1 of 2)

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(659882)

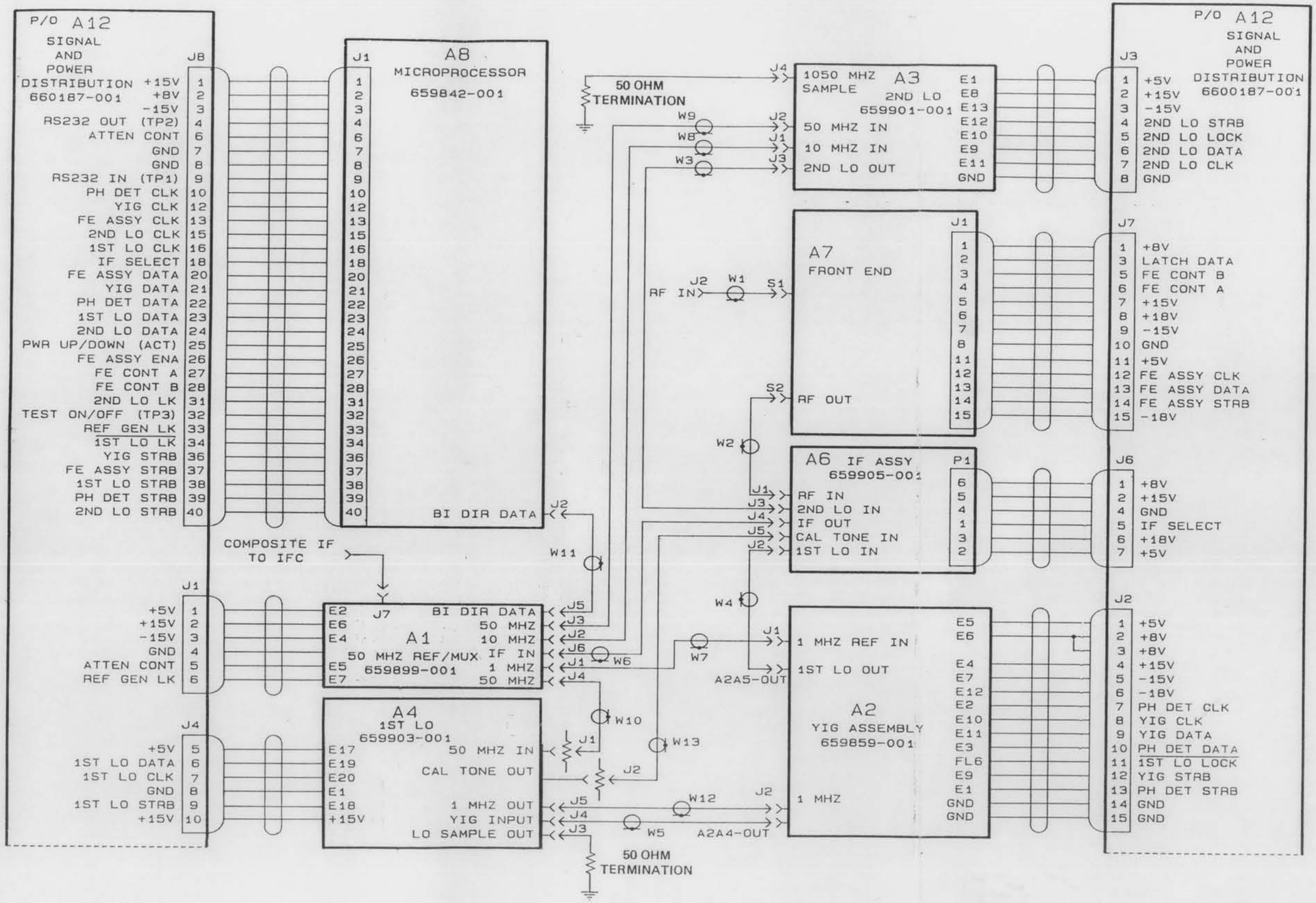

Figure 6-17. Tuner Interconnect Diagram (Sheet 2 of 2)

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